

November 23, 1959

Aviation Week

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AVIATION CALENDAR

(Continued from page 5)

Dec. 13-16—Wright Brothers Lecture, National History Park, Smithsonian Institution, Washington, D. C. Dr. Alexander D. Flitman, to lecture on "Flight in Hypersonic Flow—Physical Principles and Experimental Techniques." Dr. Flitman will repeat his lecture on Dec. 15 before the 64th Annual Meeting, on Dec. 21 before the 14th Annual Meeting, and on Dec. 22 before the 74th Annual Meeting.

Dec. 26-28—Southwest Change International Model Plastic Meet, Miami, Fla.

Jan. 11-15—South National Symposium on Reliability and Quality Control in Electronics, Hotel Plaza Hotel, Washington, D. C.

Jan. 14-23—Annual Meeting, American Astronautical Society, Hotel Plaza Hotel, New York, N. Y. (Hotel Plaza Night Banquet, Jan. 20).

Jan. 28-29—AIAA Propulsion Conference, American Rocket Society, Princeton University, Princeton, N. J.

Feb. 3-6—AIAA Annual Meeting, Welding Conference, Illinois Tech Chemistry Building, Chicago, Ill. Sponsored by American Welding Society and the American Institute of Technology, Chicago Section, American Welding Society.

Feb. 13-16—Winter Convention on Military Electronics, Institute of Radio Engineers, Los Angeles, Calif., Los Angeles, Calif.

Feb. 19-22—International Electrical Conference, Philadelphia, Pa. Sponsored by Institute of Radio Engineers, American Institute of Electrical Engineers, University of Pennsylvania.

Mar. 10-11—National Flight Propulsion Meeting, Johnson Space Center, Houston, Texas, Cleveland, Ohio.

Apr. 1-5—International Design of Space Vehicles Conference, Johnson Hotel, Santa Barbara, Calif. Sponsored American Rocket Society's Structures and Materials Committee.

Apr. 6-8—1968 National Meeting, Ultramicroelectronics-Space Research, Institute of Environmental Science, Whittier Building, Los Angeles, Calif.

Apr. 19-21—International Symposium on Nuclear Structures and Methods, Whiting Laboratory, Society Hill, New York, N. Y. Sponsored Polytechnic Institute of Brooklyn, Department of Defense, Research Agency Institute of Radio Engineers.

Apr. 26-32—National Symposium on Manned Space Station, Institute of the Aerospace Sciences, American Rocket Society, Los Angeles, Calif. Sponsored National Aerospace and Space Administration, the Rand Corp.

Apr. 29-30—International Metal & Minerals Conference, "Metals and Minerals for the Space Age," American Institute of Mining and Metallurgical Engineers, Hotel Plaza, New York, N. Y.

Apr. 27-28—National Metals on Space Age Materials, Chairman, Chapter of the American Society for Metals, Sherman Club Hotel, Cincinnati, Ohio.

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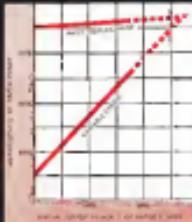
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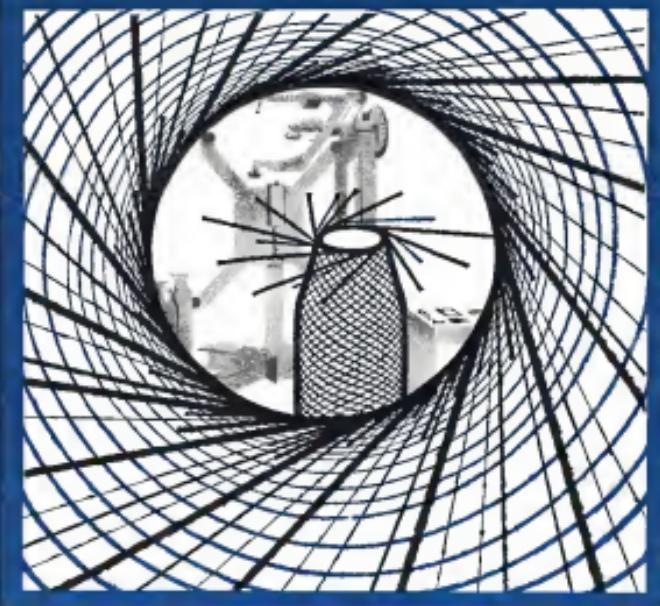
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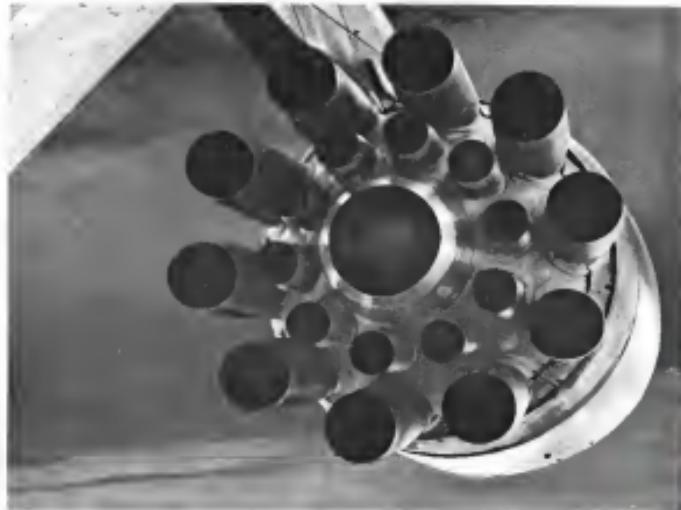
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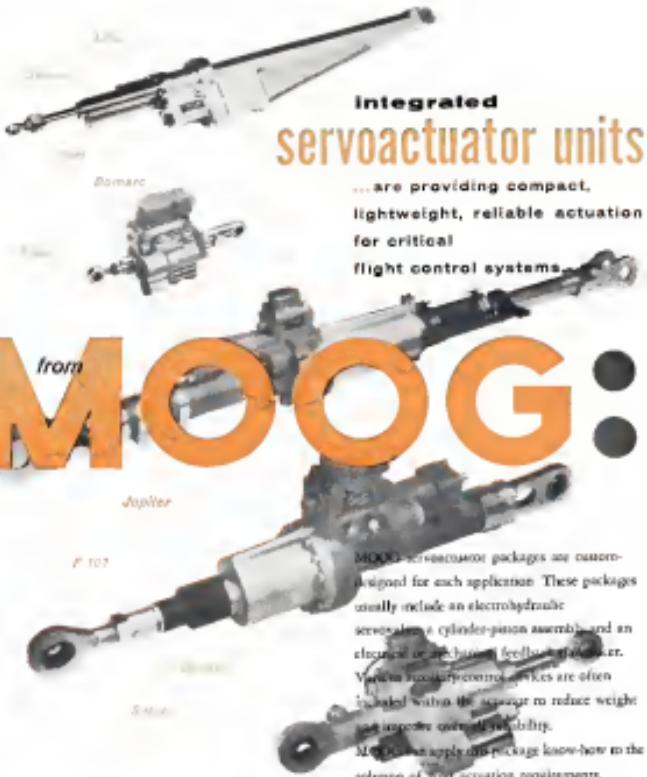


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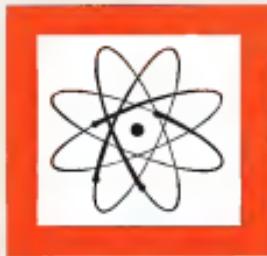
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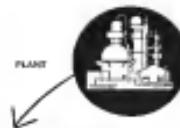
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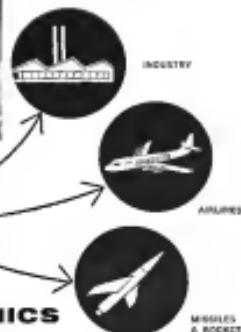
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EDITORIAL

Do We Have a Space Program?

The question "Do We Have a Space Program?" was raised at the American Rocket Society meeting in Washington last week by Dr. William Pickering, director of CalTech's Jet Propulsion Laboratory (see p. 26). This question has been raised before in Congress and by the press, but Dr. Pickering's forthright speech is the first time a major participant in the space program and a responsible man with long practical experience in the new technologies on which space research depends has raised this issue in a public forum.

Perhaps only coincidentally, one of Dr. Pickering's JPL colleagues, Dr. Eleftherios Reches, head of the JPL guidance laboratory, also delivered an even blunter blast at the scope and pace of our current space program in a Los Angeles speech. Again at the Rocket Society meeting, a sharp challenge to the prevailing official Administration view denigrating the possible military value of space research was offered by Brig. Gen. Horner Bowsher, one of USAF's most experienced research and development experts and an early proponent of a military space program.

These speeches, coupled with more uncompromising outbursts by less qualified people, are symptomatic, we think, of a rising groundswell of impatience with top-level official indifference to the national space program. This official attitude, expressed many times by President Eisenhower and his White House advisers, that space research is a largely scientific program to be pursued within stringent budgetary limitations without any regard to the Soviet program in this field and without any hope of any eventual military applications is clearly out of tune with the opinions of most scientists now working on space technology, the temper of the American people or the realities of the international situation.

Dr. Pickering bluntly emphasized that the race in space research is a fixed point in the fierce competition between the political philosophies of this country and the Soviet Union; whether we choose to acknowledge this fact or not.

"The Cold War . . . is fought for the control of worlds of men . . . The target is the domination of the emotions and intelligence of men everywhere, and aimed at being conducted by tanks, aircraft and naval vessels, it is fought in financial markets, in newspapers, on radio and television programs and by word of mouth. Drawn up in this conflict are two political philosophies both strong, both competitive and both resolute."

"One philosophy says simply that the mind of man functions most nobly and achieves its greatest expression when it is free. The other says that the mind of man is subordinate to the will of the state. It is the United States against Russia, and its most important campaign is being fought far out in the empty reaches of space."

Dr. Pickering also emphasizes as we have many times, that the most important ingredient missing from our current space program is the lack of a firmly stated and positively executed top-level determination to equal or exceed the achievements of the Russians in space. And the most important reason we need the missing ingredient, Dr. Pickering says, is above and beyond the scientific, military or economic benefits that may accrue

from such a space research program. It is to preserve and maintain our national status and prestige in the world, according to Dr. Pickering.

"This is not an easy option solely for reasons of nationalistic pride," he said, "but rather for very valid decided economic reasons. For much of the twentieth century, the world has looked at the United States as being the leader in technology and engineering. At this time, too much of the world is now taking 'in' a Russia or is it the United States which is the technological leader?"

"As a consequence, many decisions affecting our economic welfare are being made against a background of USSR achievement and development in this area. As far as the rest of the world is concerned, it is also perfectly clear that we are in a space race with Russia. It is also perfectly clear that in the post-Sputnik era, we have not within these two years succeeded in matching Russian achievements."

"We must either pursue our space developments actively and successfully, or we must decline and withdraw completely out of the space race."

Dr. Pickering proposed the following action now aimed at establishing our proper position in space technology:

- We must establish our long-term goals as a nation in our own space exploration program and then quit racing every year the Russians by another space experiment.
- We must establish goals that are susceptible of engineering achievement and which will provide significant and dramatic progress in space.
- We must clarify management responsibilities and priorities in our space program. We do not necessarily need to have a single space program, but we must clearly understand in what areas we can afford the luxury of parallel approaches and peripheral projects.
- As individuals, as professional engineers and scientists it appears to me our task is to educate the public and Congress to the realities and needs of a national space program—not only the realities of space but also the realities of time and money required to accomplish results.

"We must, with patience and understanding encourage and support those who are working working on the program. Success will come only as a logical consequence of public understanding, public support and hard engineering achievement."

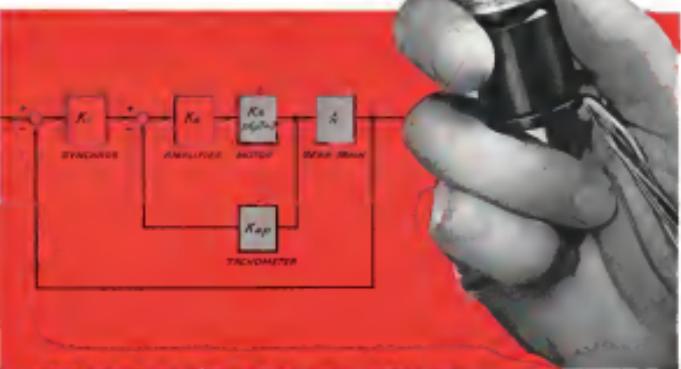
Dr. Pickering's resolutely realistic approach to the admittedly unpredictable future of our current national space program are both welcome and fully needed as an antidote to the official grid being displayed on the subject these days. Perhaps it may occur to many that a man with Dr. Pickering's technical experience and realistic view might make a more inspired leader of our national space program than some of the scientists who have been brought to the White House and its audience in the post-Sputnik era. The Administration apparently has been more concerned with using these scientists to lead technical responsibility to its current ultra-conservative policies rather than to provide the aggressive technical leadership the country needs so badly at this particular time.

—Robert Holt

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Karl J. Dresler, chief engineer.

Walter H. Vrooman, vice president and manager of manufacturing, Nastco Ultro Inc., Corp., Westbury, N.Y.

Richard A. Campbell, vice president-aerospace, Fairchild Industries Inc., Cedar City, Calif., a subsidiary of Thompson Ramo Wooldridge Inc.; Mr. Campbell was made Warren B. Hayes who has passed TAW as the president's assistant for new ventures.

David E. Shandell, vice president-aerospace, Rocket Power Inc., Menlo Park, a division of The General Co.

J. R. Johnson, executive vice president, Kroll Industries, Inc., Alhambra, Calif.
Hugh G. Bruns, vice president, Western Design Division of U.S. Industries Inc., Santa Barbara and Manzanita, Calif.; Also, Tom J. Nusselt, executive assistant to the division president.

W. R. Clay, a division vice president and engineering department manager, Radio plane, a division of Northrop Corp., Van Nuys, Calif.

Honors and Elections

Frederick F. Johnson, a director, Cal-Jet Radio Co., Cedar Rapids, Iowa; Mr. Johnson is president and director of National Radiator Corp.

George S. Macrae, a director, United Aircraft Corp., East Hartford, Conn.; Macrae is president of the First National City Bank of New York.

Peter H. Shattock, board chairman and chief executive officer of American Airlines, Inc., Los Angeles, Calif.

Carl Anderson, vice president (25-M, sec.) and general manager for American Airlines, has been elected chairman of the Meteorological Committee of the Air Transport Assn. of America, Washington, D.C.

Prof. Thomas G. Gold, director and Prof. Henry G. Bohn, research director, the Research Center for Radiophysics and Space Research, which is to have the world's largest and most powerful radar at its disposal. Prof. Gold is professor of aeronautics, a professor of electrical engineering and a professor of physics at Cornell. Prof. Bohn is a director of the School of Electrical Engineering, professor of engineering physics and professor of physics.

K. G. Chilton, vice president development planning of Northrop-McDonnell, has been elected a member of the Society of Experimental Test Pilots, Inc., Calif. For 10 years (1941-51), Mr. Chilton was senior engineer test pilot for North American Aviation Inc., during which time he conducted the first and subsequent developmental flights of experimental and production aircraft for Army and Navy.

[Continued on p. 149]

INDUSTRY OBSERVER

► Watch for the Convair F-106 to make its official attempt to take the absolute world speed record back from the Soviet Union. F-106 flies by USAF pilots at Edwards AFB, Calif., already has a 1,530 mph air-to-level flight, more than the required 35% above the 1,484 mph record recently set by the Soviet Suchoi delta (AW Nov. 9, p. 36). F-106 also will go after the official 100-km record now held by the Dassault Mirage III-A and a transonic flight of 1,600 mph.

► Free flight model of the Dornier Star has been fired at Holloman AFB, N. M., by Boeing Aerospace Co. using a Curtiss-Wright hypersonic test vehicle to boost the model to 30,000 ft. High speed test through the earth's atmosphere overflies weather conditions. Second free flight shot is scheduled for December from Holloman.

► An F-104 still has not decided on the nomenclature of the Dornier Star program. It has issued contracts to prepare proposals that would range from a rock bottom cost of \$40 to \$50 million for the first 100, the way up to \$150 million, which is higher than the figure used in the original proposals before Boeing and Martin were chosen to build the vehicle and beaten respectively (AW Nov. 16, p. 26).

► Watch for Howard Hughes to attempt to shave 30 min. from the jet transport transcontinental speed record with a Convair 880 powered by the General Electric CJ805 turbojet. Hughes has published an 850 mph schedule for delivery to Trans World Airlines and has refused to allow Convair to furnish the aircraft numbers. Record attempt probably will be based as part of the promotional fanfare introducing the 880 on TWA regularly scheduled service.

► Attempt to set a payload toward the orbit of Venus using a Thor Able vehicle is now scheduled for Dec. 10, exactly two weeks after the scheduled date for an attempt to send a Minuteman sounding rocket into an orbit around the moon using an Able Able vehicle. Both of these shots are being conducted by the Air Force's Ballistic Missile Division and Space Technology Laboratories, Inc., for the National Aeronautics and Space Administration.

► Technical Air Command will test Curtiss-Wright's Skyhook I solid rocket target launcher which fired from Nellis AFB, Nev., using Sidewinders and other air-to-air missiles in an effort to knock the target down. Skyhook has 90 sec. of powered flight, will fly Mach 3 to 4 faster than the launching aircraft.

► Unmanned nose cone carrying a camera and color film will be fired aboard a USAF Thor from Cape Canaveral, Fla., about Dec. 1. Cone is made and will be retrofitted by General Electric's Missile and Space Vehicle Department. General Electric also has been granted permission to fire a stabilized Thor and two stabilized Atlas cones carrying color cameras. The stabilized Thor payload, only shot approved thus far, will carry the color cameras in the primary experiment.

► Convair B-52 that recently broke up in flight killing its crewing test crew was conducting test runs at high Mach numbers with a B-58. B-58 was flying past Mach 2 when an outboard nacelle was deliberately cut to simulate another test effects. Aircraft broke up during this maneuver. As a result of the accident, Convair has reluctantly decided to hold the B-58 to a speed range of just above Mach 1 until the accident investigation is completed.

► Poland has built a 28-passenger four-engine MD-12 transport which now undergoes flight tests. Aircraft reportedly has a cruising speed of 177 mph and a maximum range of 279 mi. It is designed to operate from runways only 1,476 ft. long. Powered by 340-hp piston engines, the craft is 55 ft. 8 in. long, has a wing span of 69 ft. and a wing area of 502 sq ft. Useful load is 3,850 lb., flying weight is 16,500 lb.

SYNTHETIC SAPPHIRE FOR HELIX SUPPORTS

The helix tube and electron gun structure of this high-duty wave excited tube has been supported by sapphire rods. The tube was developed and built at the Electronics Research Laboratory, Stanford University, and operates from 300 to 1000 megacycles at 100 watts.

Single crystal synthetic sapphire rods are being used as support members for TWT helix and electron gun structures.

Sapphires offer linear strength of elevated temperatures, excellent dielectric properties, small-diameter rigidity, strength at elevated temperatures, low-loss characteristics, zero porosity, and economy.

In addition to rods, single crystal sapphire is available in the form of windows and domes for microwave and infrared systems. Special sapphire shapes for various applications can be obtained.

Other single crystals, such as ruby and diamond, necessary for maser amplifiers are available. 10000 sapphires single crystal yttrium iron garnet, for solid-state devices.

For further data, write to Linde Company, Division of Union Carbide Corporation, 30 East 42nd Street, New York 17, N. Y. In Canada: Linde Company, Division of Union Carbide Canada Limited, Address Department **SC-144**.



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Washington Roundup

USA Space Management Review

Extensive review of the structure of an Air Force ballistic missile space technology program is being conducted by a special committee appointed by USAF Space Force Director Douglas and headed by Dr. Clark Millsaps, president of the Edwards Institute of Technology. Purpose of the investigation should be to obtain recommendations for the "best possible management structure" to direct Air Force missile and space programs. A report is scheduled to be submitted to Douglas by the end of the year.

Other members of the committee are Dr. Hendrik W. Bode, Bell Telephone Laboratories; Malcolm P. Ferguson, president of Boeing Airplane Corp.; Robert L. Hirsh, president of Hughes Corp.; a director of Pan American World Airways and partner of Standard & Poor's Co.; Dr. Lawrence A. Hirsch, vice president and general manager of Hughes Aircraft Co.; Roger Lewis, vice president of Pan American World Airways; Charles A. Langford, Maj. Gen. James McCormick (USAFA ret.), vice president of Massachusetts Institute of Technology and former vice commander of the Air Research and Development Command; Dr. James R. Rice, Massachusetts Institute of Technology; physicist; and Dr. Jerome B. Wiesner, director of Raytheon Manufacturing Co. and a professor of the Massachusetts Institute of Technology.

Hebert Reports

Staff of House Armed Services Investigating Subcommittee headed by Rep. Edward Hebert (D-La.) has completed two reports—one on weapon system contracting, the other on contractor influence on Defense Department procurement. The subcommittee held comprehensive hearings on weapon system procurement in the spring (AW Apr. 27, p. 31) and on "munition lobby" changes in the bill (AW Aug. 24, p. 37). Because of the difficulties in concluding the fall Armed Services Committee to pass on the reports during the congressional recess, the reports probably will not be made public until after Congress convenes in January.

Meanwhile, the Defense Accounting and Auditing Division of General Accounting Office has completed a report on Air Force procurement of its budgetary resources. The report is now being reviewed at CNO's top level. The agency hopes to submit it to Congress and make it public in early January. GAO underlines the investigation after USAF refused to make available the complete audit report by the Air Force Inspector General after an agency investigation of ballistic missile management procedures (AW Nov. 16, 1958, p. 34).

Crutchfield Withdraws

Dr. Charles L. Crutchfield, \$30,000-a-year director of scientific research for the Convair Division of General Dynamics Corp., has withdrawn his acceptance of an appointment as director of Defense Department's Advanced Research Projects Agency because of criticism of the plan which would allow him to continue to direct his Convair unit while serving in the Air Force government post (AW Nov. 16, p. 28). Crutchfield would have served without compensation in the \$150,000-a-year ARPA position. The arrangement was clearly legal under a 1951 law authorizing Defense Department to retain the services of a limited number of persons of outstanding

experience and ability on a without-compensation basis and not otherwise available. Crutchfield, however, decided that "the political problems and the public relations involved have most certainly impaired my ability to serve." Defense Secretary Neil McCallum later told *AW* "most unfortunate that in this instance a situation should have developed which will prevent the Defense Department from having the benefit of Dr. Crutchfield's widely recognized scientific abilities on this important job."

Dulles: Soviet Threat Analyzed

Continued Soviet industrial growth at present-decreased rate, with "degenerate" areas in the gap between U. S. and Russian output by 1970 unless U. S. industrial growth is substantially increased, General Intelligence Agency Director Allen W. Dulles told a joint congressional investigating subcommittee last week. Dulles and future economic gains will provide the goods and the services needed to further expand Soviet military power as well as to push forward its economic penetration of animal and underdeveloped nations of the free world. He pointed out that the major thrust of Soviet economic development and its high technological skills and resources are directed toward specialized industrial, military and national power goals, while the U. S. economy is largely directed toward the production of consumer-type goods and services which add little to the strength of our national strength." Dulles also and following the present Soviet Seven Year Plan is a major goal of Soviet policy and present indications are that Premier Nikita Khrushchev desires a period of "consolidation" in which to reach the objective of the plan.

U. S. Helicopters for USSR

Soviet Union initially plans to purchase two Milovskiy B-55 helicopters and one Ventsel Model 44 helicopter, according to Vladimir Alibekov, commercial counselor at the Russian embassy in Washington. The initial programs of United Aircraft Export Corp. and Ventsel Aircraft Corp. are being reviewed in Moscow. An S-58, with maximum loadings for safety and leisure, is used by President Eisenhower and first attracted the attention of Soviet Premier Nikita Khrushchev during his U. S. visit (AW Oct. 5, p. 25). It has a maximum capacity of 17 passengers. The Ventsel helicopter, with a maximum passenger capacity, is operated by New York Airlines. Ventsel, manufacturer of the helicopter, an economic manager also noted that in 1958 the Kremlyov's Viatr Sogno last week of a Soviet Mi-4 helicopter and its designer Mihail Mr. The helicopter was much surprised by Khrushchev and deputy premier Fiodor Kozin and Anatoliy Mikoyan.

Full Scale?

A full sized USAF-Martin Titan intercontinental missile, which stands more than 100 ft. high on its display base, was mounted outside the convention hall for the 34th annual American Rocket Society meeting here (see p. 28). According to a store selling the rounds of the meeting, an American painted out to a member of the Soviet Russian delegation that this was one of the United States ICBMs. The Russian replied: "What scale model is that?"

—Washington staff

U.S. Space Officials Rap Lack of Urgency

White House attitude on military participation, need to compete cited by Peleking, Gen. Boushey.

By Everett Clark

Washington—Dissent over the confusion and lack of urgency in the nation's space programs boiled over into public criticism from program officials last week, opening what is expected to be a turbulent year of some contention, re-examination and probable reorganization.

For the first time, a key official in the civilian program directly challenged President Eisenhower's often stated view that the U.S. is not in a "space race" with the Soviet Union, and a key officer in the military program spoke out strongly on the military usefulness of space for peaceful purposes. Both the President and his scientific advisers often have expressed skepticism over the usefulness of space as a military sphere of operations and have attempted to put a civilian scientific ring on as many space projects as possible.

Strong endorsement of the current situation came from Dr. William R. Peleking in a "fascinating speech" at the American Astronaut Society's 14th annual meeting. Peleking is director of California Institute of Technology's Jet Propulsion Laboratory, which is now doing almost all of its work for the National Aeronautics and Space Administration.

"We should frankly admit that we are involved in a race with the USSR," Peleking said. "We must either press on with space developments actively and successfully, or we must define ourselves completely out of the game."

Key Objective

If it is a race, one can ask the question: Is it about domination of space? Is it for scientific development? Or is it for commercial exploitation of space? Or is it for our national status and prestige to the world?

When President Eisenhower was told in May, Oct. 22, 1957, that he had lost the U.S. Oct. 4, 1957, he responded that the issue was "whether we are competing with the Russians" in space, he replied.

"Now, this statement that we are struggling, as far as competition with the Russians is concerned, I don't know exactly what it means," he said.

"We have exhibited and it has been published, at least in outline, a program of space exploitation, and that has pointed out . . . some of the major things we want to do. Our planning is a peace-time one and I am no reason for thinking of it much as competition with somebody else. It is something we intend to do."

No Space Program

Peleking said the U.S. does not have a space program, it is a space program, since having clear national goals, management and funds to support them on a long term basis and public understanding of the importance of the program and the time and effort required to conduct it.

The Space Power Board, Dr. James B. Kifan, Jr.'s Presidential Scientific Advisory Committee put after the first two Soviet Sputnik satellites

not clear are, indeed, inter-service and intra-agency, and in some fields and facilities and manpower, it certainly occurs."

When Peleking was asked at a press conference last week who in government should admit that the U.S. is racing Russia, he said, President Eisenhower. He also said he did not hear him speak with NASA Administrator T. Keith Glennan because, at a NASA meeting and not a NASA employee, he did not have to do so.

Public Understanding

Peleking said he believes public understanding of the problem is "extremely" and indicated he thinks it is "extremely" that military and civilian organizations "are not communicating."

"Now, it would appear to me the Ellison-Snow Project must be the most important objective, and that is to accomplish the objective to equal or exceed the achievements of Russia in space," Peleking said.

Key Objective

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Long-term goals "acceptable of an growing achievement" and which will provide significant and durable program in space" must be established, Peleking said. He cited as examples of such goals the Mercury project, landing a man on the moon, making a closer look at the planets and landing a man on another planet and returning him.

It also is necessary to "blend management responsibilities and priorities," he said.

"We do not necessarily have to have a single program, but we must have clear objectives, which we can follow the hours of possible approach and peripheral projects."

Next, he said, must come education of the public and Congress to "the realities and needs . . . not only the technical realities, but also the realities of the time and money required," Peleking cited a newspaper survey that indicated three-fourths of the 2,000 people responding were "alarmed" of the atomic U.S. position and that more than 95% and they were willing to pay an addition of \$50 a year in taxes to insure that the money went directly to the space effort.

Brig. Gen. Horace A. Boushey, USAF director of advanced technology, told the ARS meeting that military aerospace programs must be developed and maintained as a matter of urgency for our national survival. In the debate on a keeping U.S. space efforts "pensional" and the legislative set-making the civilian space agency requires the term "administer" has almost become a term for "impotent," Boushey said.

"I believe there is also a lack of broad governmental understanding of national objectives," Peleking said. "The questions of the military, justify of military and civilian programs are

highly suggest that there might be military usefulness to a base on the moon on the theory that it is desirable under military doctrine to hold the "high ground."

Consequently, Boushey has attracted perhaps more criticism from those who tend to favor a wholly civilian program than anyone else in the service. The Space Power method used by Peleking indicates limited use of the space program, but he has not done much of the development of missiles and space vehicles.

Peleking, however, was asked at a press conference last No. 4, why NASA was picked to be the "one missile and space agency" when it was comparatively new and had not done much of the development of missiles and space vehicles.

"Well, I think you . . . should be making a difference between missiles, by which we normally mean weapons, and space and the industry that will be involved in exploring the space," the President said.

"Now, I cannot for the life of me see any reason why we should be using a missile industry to explore the moon. That is something that deals in the missile field, and to give that to the Air Force or Army or Navy, it just seems to me to detract what we have—a sort of disastrous situation. You have to stick to the civilian side, what is their position and not interfering with the rest of it. It stays under civilian control and that is the reason for having this agency."

This statement apparently reflects the thinking that has prevailed in financing of the civilian space program and particularly in recent transfers of rocket boosters and personnel from the military to NASA.

The first basic in that pattern was the decision to leave the Dyna-Soar boost glide vehicle with the military, and some military observers hoped it meant the beginning of a better appreciation of the need for a military space program.

The President's Nov. 4 statement was expected to cause a decrease in public discussion of space by civilian agencies, Boushey, however, that the question of whether there is a case for military space operations "is an honest question," cited as "intrinsic interest, it has been partially satisfied in the acquire by either of the military, and I think it should be discussed clearly and frankly by the military."

Boushey liked the Moon, early warning satellite and the Soviet moon mission satellite—which have just been transferred to USAF along with the Defense program—to brighten alarm of government in space.

"They are not a threat to the peaceful world either elsewhere," he said. "Further, I believe that military and space weapons at least for the

Soviets View Man-in-Space Need

Washington—Soviet Union will place a man in space only when it encounters a task whose controls cannot perform, according to Soviet scientist A. A. Blagoveshchensky, who says that then in there is no need the second space flight.

Blagoveshchensky, a member of the personnel of the Soviet Academy of Sciences, told an American Rocket Society seminar he thinks manned space flight is technically feasible now, but that Russia will send a man into space only when it has some tools for him to perform which cannot be performed by automatic instruments. He said that all present space tools can be handled by automatic methods but that when such systems cannot do the job, Soviet scientists will consider manned space flight.

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Blagoveshchensky's draft of a specific man-in-space program at the ARS meeting came with similar statements by Prof. Valerian Krasnourov, head of the Soviet space research program. Krasnourov told delegates to the 18th general assembly of the International Astronautical Federation in Moscow last summer that the Soviets have selected four astronauts for their first manned space capsule program (AW June 22, p. 76).

Russia's recently released pictures of Soviet "cosmonauts" in training (AW Oct. 25, p. 80).

Asked whether he thought the U.S. and Russia should use joint communications facilities for such projects as the U.S. Mercury program, Blagoveshchensky said it is "very desirable" to discuss such a concept, but he observed that differences in equipment might make some difficulties.

Russian Russian delegates to the 18th general ARS meeting was headed by Prof. Leonid I. Slobod, chairman of the Soviet Academy of Sciences' spaceflight commission and president of the International Astronautical Federation. Other members was Blagoveshchensky, Prof. Valerian V. Krasnourov, chief of the upper-atmosphere physics department of the academy's Institute of Atmospheric Physics, V. V. Korolev of the academy's foreign department, and Tari S. Galits, interpreter and secretary for the delegation.

Slobod, Blagoveshchensky and Krasnourov presented detailed reports on Soviet space achievements. Krasnourov and further stated it is cognition to explore the "inherent possibilities of the earth's space program and particularly its recent history of rocket booster and personnel from the military to NASA."

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use of the second probe and Mars and the last before the probe in the earth's orbit."

"This second man and second, though unexpected at the first glance, depends only time. Not from the front," Slobod said. "It is evident that such efforts should be taken to conduct drawing theoretical analysis of problems concerning the structure of planet systems and the properties of the orbits of different planets and their satellites in the solar system."

Blagoveshchensky showed a composite picture made from photographs taken for the third probe and the photograph "must be continued," and must include shots with dual illumination from the sun, which would cause surface characteristics to stand out more clearly.

Slobod was quoted last week in the Soviet newspaper Pravda as saying radio contact with the third probe was lost after its planned tasks were "fairly accomplished," possibly "as a result of a collision with a meteorite."

Blagoveshchensky added the third probe was controlled by two pairs of jets for turning it around when the longitudinal axis and one pair for turning it around each dimension axis.

responsible, fatigued will primarily assist the defender and will be of relative little value to a would-be aggressor. A military space capability second to none would be to the interest of the United States. And I believe a vigorous military space program will, more than any other endeavor, prevent world peace."

On the West Coast, JPL's Dr. Elmer-Bachard Rehlin, chief of the Guidance Research Division, told the Electric Club at Los Angeles that the U.S. has "dropped so much to a rear rank behind" in the last two years "in the process of organizing, re-evaluating, carrying on paper studies and fighting over who is going to be the boss in tell the professionals what to do."

JPL scientists recently attempted to plan missions for a fleet of space vehicles for 1984 and 1985, Rehlin said, and when they had what they thought was

a logical, technically sound program, they were directed to reduce that the goals in the first half of the program had to be reduced by the Russians.

Budget Rises Urged

The U.S., Rehlin said, should "quit being the strangle neck" for Russia and spend perhaps "the amount of money which Dr. Kellon initially estimated" at \$1.5 billion per year on aerospace research something less than 5% of our defense budget." Instead, he said, the NASA budget is "now somewhere less than the U.S. pays to ship and send surplus wheat."

Russia spent probably \$300 million to launch the first several Sputniks, he said, and as a direct result "the Russian scientific program took a huge direct jump ahead in the world market. Making a highly conservative guess of the

value of this jump, based upon the use of the world market and the use of various governmental expenditures, the cost would [Sputniks] mount a return on the dollar's worth on the order of 65 percent."

The nation needs clear goals, facilities, priorities, a very "broad-based look" at the past performance of groups and willingness to let the professionals both select and then run their own race, Rehlin said. He and one of the most effective ways to do this would be to give both support and authority to NASA to do its legal, angular job.

Rehlin also took issue with the prioritization given for the task of agency—that the U.S. is in a scientific program, not a war.

"I have not yet figured out who competing in science is very different or better than racing in second anywhere else," he said.

Previous page. Approximately 25% of the technical aspects, not counting for and plasma properties, were unique to astrophysics and about one out of ten components exhibiting at the show was its unique manufacture.

Highlights of other reports of science interest presented at the ARS meeting include:

- **Hovering satellite position sensing.** Four possible techniques for use aboard a hovering 24-hr orbital position to enable it to sense its longitudinal position and correct for it are cited and reported by Bruce B. Anderson of North American Aviation's Aerospace Division. Much is pointed out that an array of only one module as establishing satellite model propagation (SAMP) can result in a longitudinal drift of more than 77 mm per day, an undesirable characteristic for a hovering satellite intended for communication, navigation or aerospace science. The most attractive of the four techniques appears to be one called "solar lighting" which makes use of the fact that over even 24 hr the sun, the satellite and the center of the earth should be on a direct line with one another. Using an electro-optical sensor to establish the distance to the sun and an infrared or electro-optical sensor to establish the direction to the earth's center, plus a moderately accurate drift, the array of modules can determine the desired hovering longitude. The self-aligning technique requires an accurate determination of the direction to the earth's center measured as an error of one minute of arc results in an error of about 7.7 m in determining position.

• **Electrostatic field measurement.** The fields have not been environmental on earth, but the use of an electrostatic field sensor module which need not be in use transverse, azimuth and correct a vehicle configuration, possibly because of lower heating velocities.

• **Atmospheric field sensor.** An array of 10 to 40 Lee for the design of its new space vehicle communication system. While the system is designed for use in the upper atmosphere, it will be used in the lower atmosphere and space and Dura-Sensor resists it. It will permit transmission of telemetry data, command control, compressed bandwidth voice or data. Systems will have a data capacity of 1,000 samples per second giving a data bandwidth of 800 ppm, using pulse position modulation (PPM), or 400 ppm if provision is made to transmit a modulation pulse. Pulsing equipment is now being built.

• **CEC's test of HF communications systems.** Frequency, generated by USAF's Ballistic Missile Division, will investigate 7, 14 and 29 m using a 30 W transmitter. Two types of antenna will be employed as flight test. One, used on semi-trailers, vehicles, will consist of a coiled flat monolithic slot antenna. It is being linearized in the surface of the metal trailer body so as to provide the best possible performance. For a trailer's trailer, the antenna will consist of a centered flat slot formed by insulating an inner space wave guide from the main body line for waveguide feed.

• **Star's ARS meeting had a** larger number of reports devoted to acoustic techniques and devices than in

truly weak magnetic fields sufficiently sensitive to measure interplanetary fields in space probe vehicles was described by J. P. Hopkins of the National Aeronautics and Space Administration. The new technique uses magnetometers developed by Varian Associates under NASA sponsorship to be flown early next spring in Jupiter probes. Mounted corner, weighing less than three pounds and consuming less than three watts of power, it is believed to be used in space probes to be launched in mid-1980. Hopkins said Rakuten's magnetic sensor had the advantage of lower power consumption and higher sensitivity in weak weak fields (10-2 to 10-3 gauss) as compared with the older proton-type device. In addition, the new instrument has shown considerable ability to measure superconducting cyclotron fields of as little as 10-6 gauss.

- **Regenerative fuel cell.** Power source for space vehicles capable of supplying 550 watts continuously at 28 volts utilizing a classical nuclear regenerator fuel cell was proposed in a report by M. G. Del Dea, J. M. Fister and T. A. Johnson of Thompson Ramo Worrell, Inc. The system would have an overall thermal electric conversion efficiency of 11%, a value high enough to be 216 kg. The proposed fuel cell would use liquid lithium and hydrogen as fuels residing in the cell to generate chemicals. Ramo products would be

dispensed in the cell's melting salt electrolyte which would be passed to a de-composition chamber where they would be dissociated to the original fuels by application of heat from a small nuclear reactor.

- **Solar energy storage.** Use of the high heat of fusion of lithium boride may provide a very efficient means of storing solar energy aboard a space vehicle for subsequent use when it is shaded from the sun, according to a report by C. L. Walker, J. D. Marder and J. E. Hart of the Air Force Defense Contract Monitor. When a cell is shaded, the heat energy would be stored in lithium boride, cooling it from heat to liquid form. When the cell is in the shade, the process would be reversed with lithium boride, giving off heat to the working medium that powers a nuclear vapor turbine engine in a Stirling cycle engine. Used with a nuclear vapor turbine having an efficiency of about 10%, or a Stirling with an efficiency of 30%, it would give lithium boride an overall energy storage capacity of 14 to 12 watt-hours per pound, the researchers said. With improvements in heat exchanger design and lithium boride purity, the figure may be raised as high as 66 watt-hours per pound. By way of comparison, batteries have a stored energy capacity of about 10 watt-hours per pound. Fuel cells and batteries have capacities of about 10 watt-hours/pound, they said.

Boeing Aims at STOL-VTOL Field By Proposing Merger to Vertol

Boeing Airplane Co.'s proposed acquisition of Vertol Aircraft Corp. is a move to complement its long-haul aircraft capability by moving into the short-haul and commercial-type vehicle market.

Vertol, which two previous merger discussions with Northrop Corp. and Bell Aerospace Corp. failed to develop, would become the Vertol Division of Boeing. Its shareholders would receive no shares of Boeing common for each share held of Vertol and Boeing would issue 950,000 shares or about 6% of the combined holding shares now outstanding to make up the difference.

Both firms—let's call Vertol the flying helicopter—want to merge. Each stock, traded in the unannounced development in price, Boeing 3 of a point to 32 and Vertol from 22 to 20.5. Instead, sooner or later, regarded the chances for final approval as good since the stock exchange, a stockholding, to more than 500,000, was agreed to. One company source was optimistic of the plan's approval, pointing out that the negotiations had seemed in a very solid, fair

footed, but he also noted the uncertainties involved in any acquisition plan.

Boeing's Product Records staff (AW Nov. 9, p. 16) recommended some minor changes that Boeing get into the STOL/VTOL field as a major market with potential for substantial production of helicopters. To do this, Boeing had the choice of developing its own capability or else buying Vertol's into the market by the purchase of some or all of its capabilities. Boeing chose the latter.

By moving into this area, one source pointed out, Boeing could be in a position to benefit in the long run if it based its future on the fact that the great improvement in speed of jet aircraft might be satisfied by short-to-medium range or delays in executing short-haul services.

Vertol's two wholly-owned subsidiaries, Allied Research Associates and Canadian Vertol Aircraft, Ltd., would continue as separate corporations as Boeing subsidiaries. Vertol and its subsidiaries would retain their present management.

Space Technology

By Philip J. Klass

Washington—General Electric and Aero scientists seeking to elaborate the blocking of radio communications between ground stations and space vehicles or missile nose cones during atmospheric reentry are exploring new techniques into frequencies at opposite ends of the spectrum. It was reported here during the American Rocket Society meeting.

Heavy attenuation of radio signals that occurs at regular VHF television frequencies during reentry is due to absorption in the upper layers of the atmosphere. Frequencies above 70 kHz are less affected by the plasma absorption compared, but presently available components and equipment for operation at this frequency lack the required reliability, White said.

Atmos therefore has selected the frequency band of 10 to 40 kHz for the design of its new space vehicle communication system. While the system is designed for use in the upper atmosphere, it will be used in the lower atmosphere and space and Dura-Sensor resists it. It will permit transmission of telemetry data, command control, compressed bandwidth voice or data. Systems will have a data capacity of 1,000 samples per second giving a data bandwidth of 800 ppm, using pulse position modulation (PPM), or 400 ppm if provision is made to transmit a modulation pulse. Pulsing equipment is now being built.

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NATO-Wide Research Project Proposed

Washington—Recruitment that the 15 North Atlantic nations put their hands in space research may be made by the science and technical committee of the North Atlantic Treaty Organization's "preparliament" conference which met last week.

The conference is composed of representatives of the legislative bodies of NATO countries. Its recommendations may influence negotiations for the next intergovernmental treaty, but are not binding on the North Atlantic Council which will meet in London in April. The council is composed of the defense, foreign, and finance ministers of the member nations.

Sen. Henry Jackson (D-Wash.), chairman of the science and technical committee, said in presenting the group's report to the conference that "there is nothing wrong with bilateral arrangements" for cooperative research in space "provided we do not stop there."

He added:

"The free world space effort is now like a football team with half its best players sitting on the bench. Secretaries from every one of the 15 NATO nations present staffs which are incapable

of space research. Yet this previous scientific talent is a growing resource which cannot but have a cooperative space program."

Jackson said he witnessed the collapse of a scientific space program under the United Nations but pointed out that "years of talk and negotiation would be needed to make even a beginning at solving them."

White Views Space

Gen. Thomas D. White, USAF chief of staff, told the conference that satellite and space operations "clearly have tremendous strategic implications" for NATO. He said they indicate that true global warfare should be based on orbital weapons systems in strategic orbits.

Gen. White also implied that technological development in aerospace may eventually dictate the withdrawal of U.S. forces from the European land area.

He said:

"When the NATO strategy was first conceived, the world's impact, in terms of time from the U.S., would not set in for 15 hr or more. Today, the point of the world could be on the target within 30 min minutes. The difference lies in the capabilities of fighter-bomber aircraft compared with those of the intercontinental strategic ballistic missile."

Gen. White also predicted that these developments will have tremendous impact on future NATO strategy.

• **Aerospace nuclear propulsion.** "Naturally, when one thinks of aerospace nuclear propulsion, one thinks only of nuclear-powered aircraft. We think of aircraft which will have almost unlimited endurance and possess their offensive value when armed with antisatellite missiles. The achievement of efficient and effective aircraft will also depend on the use of weapons in terms of effort and delivery. But, we could anticipate that aerospace will give us increased combat capabilities and a stronger deterrent."

• **Nuclear rockets.** These, he said, will possess "exceptionally increased thrust which will make possible the launching of high payload satellites and surface-to-surface missiles."

• **Nuclear targets.** These "offer the promise of low altitude, high speed, long range missiles which could engage our strategic ballistic missile forces."

The specific recommendations of the NATO science and technical committee, together with Jackson's committee, are:

• **NATO center for space studies** should be established. "This need not, and should not, be a huge enterprise," Jackson said. "Such a center could be

established at any one of a number of existing space centers, laboratories, or research institutes, either in Europe or North America. It could serve as a common meeting place and feed point for space scientists from throughout our community."

• **NATO-wide space "hardware" program** should be developed. "As space research and technology there is no substitute for mobility," he said. "Mobility and the first NATO-wide venture should be "a bold and massive audacious enterprise" than an earth satellite program."

• **Inventory** should be made of the human and institutional resources available to the NATO community to support space research and exploration. "Much of this talent is now going unused," he said.

• **Greater interchange** and closer cooperation in both basic and applied space research should be made. "Today's uncoordinated and independent national programs too often result in overlapping and duplication of effort," Jackson said.

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F-104s Leave ADC

Washington—An Defense Command will withdraw its total complement of Lockheed F-104A and B model fighter planes by the end of November, possibly only in 1968.

USAF officials indicated the principal reason for pulling the F-104 out of the Air Defense Command was its lack of all-weather capability, inability to operate within the SAGE system and relatively short range in relation to the North American air defense problem.

Lockheed F-104C and D fighter-bomber versions will remain in service with the Tactical Air Command. USAF and its four plan had been made for disposition of the F-104 coming out of ADC. Redefinitions were that they probably would be offered to the foreign military air programs with the Chinese Nationalist Air Force based on Taiwan as a likely recipient.

F-104s, worth of the A and B fighter models, have been involved in at least six accidents in the past few weeks. These were:

• F-104A of 137th Fighter Interceptor Squadron, at Wiesbaden AFB, West Germany, Oct. 27 during a return to its home base, killing two pilots. These developed as a result of low oxygen pressure system malfunctions. This was the first accident for this squadron, which had recently won a safety award.

• F-104A of Group 40, USAF, based out over the Germany range on Oct. 28. Pilot ejected.

• F-104A, crashed on Oct. 28 after takeoff at Duxford when the engine flamed out. Pilot ejected safely, but the plane ended up in a hedge, taking three children.

• F-104 had a partial failure on takeoff at Duxford, resulting in a 40-ft. ditching, and the pilot ejected safely. He stood with the plane, which is reportedly, sustaining minor damage to the gear. An Air Force officer to this as an accident, rather than an accident.

• F-104B forced out on Nov. 11 to land from Hanover AFB, Calif. The pilot ejected and plane went in. Gun was still down at time of impact.

• F-104 was involved in another collision in the vicinity of Tinker AFB, Okla., on the night of Nov. 12. Pilot ejected.

Second Titan B Try Scheduled This Week

Washington—Second attempt to launch an Air Force-Martin Titan B missile to test propulsion as both stages in test flight scheduled for late this week. Titan thus far has experienced a 90-day delay between flights because of damage to a pad and procedural problems further back along the hydrochloric-acid pipeline.

A 40-day delay for repairs followed the explosion of missile B-3 at Pad 19 at the Air Force Missile Test Center's Cape Canaveral, Fla., launch site last Aug. 14. This was to have been the first test of secondary propulsion.

Other possible flight problems, including damage to one missile valve, the transposing aircraft lost pressurization, accounted for the rest of the delay.

Expllosion of the B-3 is being blamed partly on a memory switch in the ground equipment that was grounding itself electrically and failing on safety requirements that, in this case, turned out to be a disadvantage.

Job of the ground equipment from this failed was to receive a signal from the automatic motor operational controller and then release energy to detonate the four explosive bolts that held the missile to its launch stand. Because the equipment was faulty, it triggered the bolts prematurely.

• Titan's first stage engines developed 39% of their thrust in the first second, but this low thrust and poor acceleration was not enough to restore the development flight. When the bolts triggered prematurely, the missile began lifting off the pad.

A safety feature built into the master operational controller for test launching requires engine cutoff if unbroken cords did not disconnect simultaneously. Because of the premature lift-off, disconnection of one unbroken cord was lagging, and the signal was sent through the controller to tell the engine. The result was that the missile lifted 12 ft. and fell back to the pad.

Analysis of engineering data indicates that the impact of the missile's fall set off a sequence of events that took the full length of the two stages and as intended to destroy the missile on a signal from the safety device.

If the safety cord had not disconnected the missile when it did, damage to the pad might have been even greater. Recent explosion of the Atlas Able launch probe launcher, caused by a propellant leak sheath after the engine was shut down following a short start-up, caused pad damage that is expected to take four months to repair.

The general equipment that failed in the launch attempt has been redesigned, and the safety requirement eliminated



Plastic Heat Shield Fitted to Mercury Capsule

Memorandum afterburner of Little Joe Mercury test capsules are being fitted with a 1-in. thick heat-shielding shield (above) composed of several layers of polyimide resin/glass fiber composite, developed by Dornier Flablon Division of Hoechst Chemical Corp., resin is designated Hetoxy-72. Below, McDonnell Aircraft engineers shown detail of lifting the capsule in water. Flotation bags are automatically inflated on impact. (AW Oct. 13, p. 29)



Nuclear Auxiliary Space System May Be Operational Within Year

By Craig Lewis

Washington—Small nuclear auxiliary power system designed for space vehicles is currently awaiting a prototype form and is expected to operational within a year.

The experimental reactor is designed to produce heat for a space auxiliary power system that will operate for one year, says James H. McCone, director of North American Aviation's Division of Nuclear Power Systems. The reactor has been tested at design power and temperature at a company-operated AEC facility in the Santa Susana Mountain west of Los Angeles.

SNAP reactor was developed for AEC's Systems for Nuclear Auxiliary Power program under the SNAP II contract. It parallels SNAP I and III programs based upon use of iodine-tubes to operate power conversion equipment. SNAP II experimental reactor system was developed under a \$6.5 million AEC program, but production units are expected to cost about \$800,000.

AEC Chairman John A. McCone estimates that the SNAP II reactor and power conversion system will be operational for the first flight in 1968. The reactor will be developed to a version of the American Rocket Society's test reactor. He also reported progress on these funds.

• **Development cost is much lower** for the reactor since the major portion of engine costs can be cut out with the small individual component engine. Projected development cost would rise to \$10 million, or about 25 percent over 60 percent, significantly increasing its cost to vehicle performance, he said.

• **Mission conditions will determine which engine system is selected.** The reactor problem would be the choice for research programs requiring early availability of a small number of reactors at a given thrust level, owing to the reactor's reactor advantage in reliability and its lower development cost. For long-range nuclear programs requiring several thousands of operational vehicles, the single engine problem would be obvious because of its higher ultimate reliability, superior performance and lower operational costs. J. P. Hinds and C. E. Kaplan, also of Rocketdyne, emphasized the importance of the development of safety and reliability for reentry payloads. These low-cost considerations, they said, will determine the use of engines for reentry applications which do not have the safety and reliability desired.

To improve upon this, they evaluated a number of approaches that would significantly improve mission safety and reliability but that, at the

same time, would detract from overall mission reliability. In order to maximize mission reliability as much as possible, while holding the increase in mission weight to a minimum, the two engineers suggested the use of two engines, suggesting the use of two separate liquid oxygen tanks for the clustered liquid oxygen engine system. These are the "engine trade" decisions, permission for hold down, "These OK," indicated the two project managers of the testing facilities before its full development was completed.

The engine, which would have a burning time of 60 sec, would be 107 ft long, 20 ft in diameter and weigh 1,000 lb. It could put a 60 lb payload in a satellite orbit or a 10-ton payload on the moon. The large size of the engine would necessitate on the propellant loading and engine fabrication unless the engine could be manufactured in large.

Development of new engineering techniques for space fabrication would be the only new development needed. The rest, again, would be a matter of scaling up existing technology. The test vehicle, which is to be the first flight, would be about three tons, cost to the first flight would be approximately \$70 million. Cost of each engine in the production stage is estimated at \$4 million.

Plastic Units

Plastic parts would not represent an improvement but support Novak said. He would use solid versions of plastic parts Thielot had developed in a time offset with a number of other companies.

Although the subject of this study appears to be considerably beyond the requirements of the recommended Air Force board, present space parts to the study are considered to be 10 years off the Thielot's Dec. 15 proposed Mier Study probability, however, is that the study will probably be turned into a proposal as far as procurement at a later time.

• **Aerospace**, while wanting to make definite projections much beyond the level sought in the present Air Force requirement, agreed that it will not threaten to approach the limit attainable with solids. So far as the other problem is concerned in putting a man on top of a solid propellant on orbit, Aerospace's Richard Goeddeli proposed that it would be extremely difficult to catch an explosion in time but felt that the inherently high reliability of a solid propellant engine might be counted as to other side problem.

• **Williams**, the Space Technology Laboratories, discussed the growing need for and problems involved in static testing under altitude conditions. Observed by the increasing importance of space work, aerospace and space engineers are now developing safety and reliability test that, at the

same time, would detract from overall mission reliability. In order to maximize mission reliability as much as possible, while holding the increase in mission weight to a minimum, the two engineers suggested the use of two engines, suggesting the use of two separate liquid oxygen tanks for the clustered liquid oxygen engine system. These are the "engine trade" decisions, permission for hold down, "These OK," indicated the two project managers of the testing facilities before its full development was completed.

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• **Project Photo** nuclear reactor program is progressing rapidly and "we scientists are so sure of success—despite multiple problems yet unanticipated—that we are willing to forecast not only when the demonstration unit will be powered but also when the reactor will be ready for operational use."

• **First experiments** with Project Rover nuclear rocket program using bismuth fuel confirm theories concerning the very high specific impulse attainable by such reactors, says McCone and it appears that both bismuth and iodine will be "the favorite energy of the future—the very high specific impulse obtainable by a nuclear reactor."

• **Development** of a nuclear-powered aircraft is important, and "it must be brought into useful reality in the shortest possible time," McCone said and it is desirable to choose the test prototype of the two concepts currently under study for nuclear aircraft power and to concentrate on it. "This is one of the tough decisions that need to be made—size and—size and we as a nation must face up to it with resolve."

SNAP II experimental reactor is housed in a cylinder 14 in. in diameter and 18 in. high, and it weighs 220 lb without shielding. The reactor is fueled with enriched uranium. In the power conversion system, heat from the reactor will be transferred through a liquid sodium coolant to a boiler where the heat vaporizes ammonia, and the ammonia vapor will drive a turbine. Nitrogen will be used to cool the reactor and also lubricate bearings in the power generation system.

Turbine-generator is the power conversion system which uses a 300-kW Mervin vapor-driven turbine drives a generator to produce the three kilowatts of power. Life of the system is basically limited by the life of the moving parts in the conversion system. Components were developed by Thompson Bros. Windham, Inc.

McCone and the SNAP II reactor is the smallest known operating reactor in the world to be a self-contained system. In its operational form, the reactor and heat power system will go into operation in space when the reactor is activated by a ground signal. Signal will not be used until a successful long-term order has been established for the reactor.

• **Washington-North American Avia** bns., Inc., may change the damping stock controls the rate of speed of X-15 research aircraft's roll shaft. Jack et al. say that this may be the best fix to solve a troublesome problem that has come to light in the flight test program for the aircraft.

Apparently, certain design features for the plane's landing gear have turned out to be deficient, according to the flight test results. Dragging was low on the first flight, while the aircraft contacted the ground at the bottom of one of the pitch oscillations which developed in the first approach and were overcome by the crew. McCone and Jack et al. say that "the harmonic energy of the aircraft—the very high pitch rate obtainable—was not as needed in the aircraft engine."

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This factor makes the SNAP II reactor and during launch because the reactor is cold until ignited, while the reactor is continuously hot. Both present problems on reentry when they might contaminate the atmosphere at their entry vehicles burn up.

News Digest

Soviet Passes Nabi Khodzhayev, editor of the Soviet journal *Space*, has said the "150 people who brought mankind out of this earthly life" of the plant we visited in one year," and said his recent announcement prepared not based upon nature, political or economic conditions.

Scheduled strike of Team West Airlines routes set for Nov. 18 was averted last week when the carrier and Air Line Stewards and Stewardesses from agreed to arbitration.

Planned Aircraft Corp. will develop a successor to the VZ-2P small jet aircraft. VZ-2P, originally designed 35 ft H by Pascual, will have slightly larger fins (blades) which will be tilted to permit higher speeds. Blades will be used instead of wings and standard dual control will be used to be controlled. Powerplant will be two 425-cu-in. Avcoets IIC gas turbines. VZ-2P has the Avcoets IIC (AV-1) and H-1, p. 32.

General Electric's Military Electronics Department was awarded a \$24 million USAF contract for production of its AN/FPS-24 radar capable of detecting, tracking, identifying at long range, deceptive aircraft and evading countermeasures. The radar will be built into the SAGE system.

Flying Tiger Line will sell \$5 million in 51% convertible notes to the New York Central Railroad for the purchase of new equipment. Notes are convertible to common stock at \$25 per share for 10 years and \$25 per share for 10 years thereafter. Proceeds will be used to purchase aircraft and equipment for the 10 Canadian CL-44D turboprop all-weather transports now on order.

National Aerospace and Space Administration's Project Tissue automated satellite, scheduled to be boosted into a 400-mile orbit in October, will be launched on Oct. 12 from Cape Canaveral, Fla. Payload man can carry up to three television cameras with varying degrees of viewing resolution. Radio Corp. of America is furnishing the payload under Army Signal Corps contract.

AIR TRANSPORT

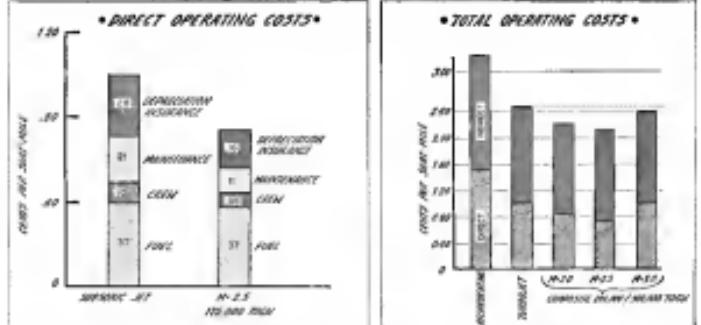


CHART at left shows sharp drop in Mach 2.5 at maintenance costs. at right is comparison of operating costs of these types.

Study Predicts Mach 2-3 Transport Costs

ARDc-sponsored project concludes that fuel will be major item; greater productivity is also cited.

By William S. Reed

Los Angeles-Superdense transports, designed and built with today's technology and using conventional fuel, may find their most cost-efficient mission in the Mach 1.5 to 3 range.

Such aircraft would be nearly 20 times as productive as a military logistic role at the Douglas C-124 Globemaster. Similarly, the supersonic vehicle would prove more productive than propulsive or subsonic turbine-powered transports in a commercial role, according to a recent study in Planning Research Corp., Los Angeles, under contract to Air Research and Development Command.

No attempt was made in the study to assess the feasibility of developing such a transport, but rather the focal point of the study is the economic means of operating such a vehicle.

Goals Objectives

The study was undertaken to fulfill three main objectives:

- Provide a comparative analysis of propulsive, high speed subsonic, hybrid transports and supersonic transports, both in the military's view and in commercial airline operations.
- Forecast potential demand for supersonic transports in the domestic and world-wide commercial markets.

An attempt was made to optimize a particular supersonic aircraft design or to provide a comparative evaluation of particular designs. This goal was pursued by a relative cost comparison covering

the entire spectrum of proposed supersonic transports. Cost comparisons made show the effect on operating costs as (1) takeoff gross weights are varied, (2) design speeds are varied, and (3) design wings are varied. A comparison of the cost of supersonic transports with conventional transports and current subsonic transports.

Forecasts of the commercial air traffic volume in the 1980-1975 can also have been made in order to predict the potential commercial market for supersonic transports.

Cost Comparisons

Cost methods, devised to permit the comparative cost analysis between present aircraft and the proposed supersonic transport, allow for and include relative cost comparisons to be made according to the study. Six aircraft are considered in order to form a basis for comparison. In cost curves, lines of trends are considered and the figures then extrapolated to fit the supersonic transport era.

Costs costs are determined by an among the existing policies of the Military Air Transport Service in the use of the military transport and by analyzing the trends occurring between aircraft productivity and costs ratios as determined by comparison with air line and airline flight time per personnel. The analytical models provide a basis for extrapolating new costs into the future.

Maintenance costs are projected in

such a basis the subsonic jets and supersonic transports with the analysis of correlations frequently used to predict maintenance costs. Additional information includes the cost of aircraft design, manufacturers (e.g. engine manufacturers, maintenance, aircraft design, structures), and the consideration of operational factors which may affect maintenance costs prior to the high speeds at which the aircraft may operate. Also considered are labor costs projected from the historical relationship between aircraft weight and labor costs and the historical relationship of aircraft labor costs to material costs.

Fuel cost estimates are based on the worldwide interplay of price for the USAF and, in the case of the aircraft that more efficient for jet fuel in long range aircraft, allowing for a lower cost per gallon federal fuel. In determining fuel cost, Mach numbers from 1.5 to 1.8 with life to drag ratios of 9.5 to 7.0 were considered with specific fuel consumption for both supersonic and non-supersonic aircraft.

Depreciation is estimated by analyzing annual capital costs as proposed by the aircraft industry. Depreciation costs are based on a procurement program of 100 aircraft having a 10 year useful life.

The study also assumes a 10% residual value for both the aircraft and engines. For the military transports, a 5% fuel efficiency is assumed and for the commercial version, 8% fuel efficiency.

Mach 2.5 appears to be the most efficient speed for supersonic transports, assuming constant takeoff gross weight. Based on the assumptions and operating and design characteristics, particularly specific fuel consumption, and does not measure the fact that future supersonic aircraft will benefit operating costs at Mach 3 well more than those at Mach 2.5. Specific aircraft development programs should, therefore, consider speeds in

the area of Mach 3, as well as those in the area of Mach 2.5, in order to take advantage of the greater growth potential at the higher speed.

Superior efficiency of the supersonic transports is demonstrated in terms of operating costs per available ton-mile, particularly at speeds in the area of Mach 2.5. Superiority of speed at speeds in the area of Mach 2.5 appears to be more efficient than advanced subsonic cargo jet transports. Even at speeds in the area of Mach 3, supersonic transports appear to be competitive with the swing-wing cargo jets except at extreme ranges.

Prediction of various transport aircraft was determined in order to develop a cost per available ton-mile per hour to that economic comparison among various transport aircraft could be made. Results in judgments of the importance of the information from the analysis made by Planning Research Corp. As an illustration, for aircraft of approximately the same takeoff gross weight and at a range of 1,000 miles, rate of production of a Mach 2.5 transport is about 20 times greater than Douglas C-124 Globemaster.

Comparisons also are made between aircraft initial cost and available productivity. Initial cost per ton-mile of available productivity was obtained by dividing the initial factory cost of the aircraft by the available ton-miles at the range indicated. This example shows that the aircraft are most efficient operating and design characteristics.

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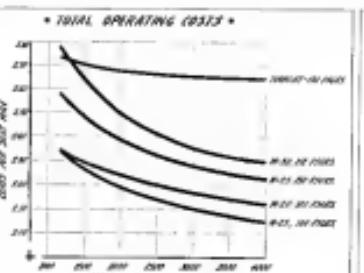
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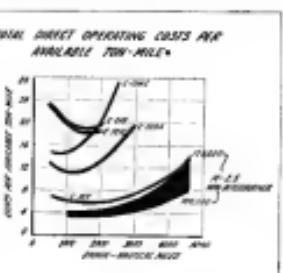
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At the same time, the study found that



SEAT MILE costs drop when plane gets into Mach 2.5 envelope (left). Mach 3 planes (right) have lower operating costs than USAF aircraft



design speed and design range held constant in the family of supersonic transports (both afterburning and non afterburning), efficiency increases as takeoff gross weight increases. Effect of afterburning weight increases, effect of increasing range decreases. The last but often the heaviest costs of operation are increasing as the aircraft becomes larger, products of which is a much more rapid rate.

This analysis is based on available two-wide productivity. No consideration is given to load factors or other qualitative factors, such as frequency of service, birth of which factors are used to support smaller transports. In selecting a particular takeoff gross weight, consideration must be given to these factors. However, optimization of aircraft size now falls within the scope of the study, which it is apparent, is to be done in the relative effect on costs with variation of the other parameters considered.

Fuel Costs

Fuel costs become a more significant part of selected aircraft operating costs in the speed of the supersonic transport increase. When fuel costs represent about 20% of the selected aircraft operating cost at a C-141, fuel represents 65 to 70% of the selected aircraft operating costs for a Mach 3 transport. Although the study indicates that Mach 3.5 appears to be the most efficient aircraft from a cost point of consideration directed at specific transport research and development, passenger load rate into account the fact that, as indicated, aircrafts are made, Mach 3 will rapidly become a relatively more efficient speed. Productivity at this speed is such that rather small decreases in fuel consumption result in significant decreases in operating costs and these decreases are obviously larger than those which will occur at the Mach 2.5 speed. For example, 10% decreases in fuel consumption at Mach 3 at a design range of 1,000 miles would result in a 9% increase in productivity. For the same case at a speed of Mach 2.5, a 10% reduction in fuel consumption results in only a 6% increase in productivity. Operating costs for the two cases will be affected correspondingly. Planning Research Corp. concludes that any specific aircraft program should consider the Mach 3 range as well as Mach 2.5 in order to take advantage of the potential benefits of the faster speeds.

A comparison of selected aircraft operating costs per available seat shows that the supersonic transport remains competitive with subsonic cargo jets and ranges over 3,100 miles. The results of the report point out that the cargo jet and to illustrate the cost factor is a second generation develop-

ment, in using all model, of present subsonic transonic transports while the supersonic transport reflects the performance of a first generation aircraft. Even when total direct operating costs are available, these must be considered which include the cost of fuel, interest on capital, insurance, etc. The supersonic transport would operate for a cost of 2.07 cents in seat mile efficient aircraft dry behind-the-queue operating cost is about 2.67 cents per seat mile.

Projections of the transonic passenger market also are made to determine, within reasonable limits, the commercial market which might be served by supersonic transports in 1968-1975. Projections of total aircraft as well as of possible first class aircraft in five major price categories within the horizon of the commercial U.S. and international will be made in the U.S. and foreign aircraft manufacturing and by foreign countries themselves.

Long haul portion of total aircraft revenue subsonic market reflects the operating cost of a supersonic transport. Related to productivity, however, not at fuel per seat mile, is the same as for a 175,000-lb. Mach 2.5 supersonic transport as for the subsonic transport.

• **Efficiency** of a supersonic transport is superior to that of a subsonic fuel-economized transport and the margin of superiority extends even further over the supersonic cargo aircraft.

• **Fuel costs** are the dominant aircraft system, will represent over half the direct operating cost of a supersonic transport. Related to productivity, however, not at fuel per seat mile, is the same as for a 175,000-lb. Mach 2.5 supersonic transport as for the subsonic transport.

• **Efficiency** of a supersonic aircraft will be less economical in commercial operation than the higher aircraft because it appears that total capital, cannot uniformly translate into passenger load rate.

• **At Mach 2.5 transport appears to be the most economical.** However, from a financial point of view, the Mach 3 transport has speed needs of consideration.

• **Using the standard of direct operating costs**, the Mach 2.5 supersonic transport, weighing 175,000 lb., 100,000 lb. in more economical than the subsonic transport. On a per seat basis, fuel costs are equal but in other categories of direct cost the supersonic transport is 35 to 50% less expensive due to its superior productivity.

• **Indirect costs**, which represent approximately 50% of total operating cost in commercial operation at Mach 3 at a design range of 1,000 miles, would result in a 9% increase in productivity. For the same case at a speed of Mach 2.5, a 10% reduction in fuel consumption results in only a 6% increase in productivity. Operating costs for the two cases will be affected correspondingly. Planning Research Corp. concludes that any specific aircraft program should consider the Mach 3 range as well as Mach 2.5 in order to take advantage of the potential benefits of the faster speeds.

When indirect costs are added to direct costs, configuration up to 300, 000 lb. at Mach 3, as well as Mach 2.5, are found to be less expensive and superior to most turboprop aircraft at an operating range of 2,500 seat miles.

• **Seat mile costs** are also projected as they are with range and selected operating ranges. Seat mile costs are calculated at a design range of 1,000 seat miles if a shorter design range is desired, resulting

capacity should be increased with a resulting decrease in seat mile cost.

Costs efficiency of the supersonic transport is again evident by the fuel cost for a design range of 6,025 seat miles at a Mach 2.5, seat mile cost of 2.07 cents in seat mile efficient aircraft dry behind-the-queue operating cost is about 2.67 cents per seat mile.

American Shuffles Management, Appoints Sadler General Manager

By L. L. Doty

Washington—American Airlines last week announced sweeping changes in its top-level management group which places G. Marion Sadler, a sales executive, in the newly created position of vice president and general manager.

With eight department heads in standing place, new vice presidents, reporting directly to Sadler, the former vice presidents and senior aviators will direct the administration of the company's business areas. G. R. Smith will remain controller of the financial and accounting areas.

Patricia G. Smith, who will continue in long-haul planning, passenger sales will report directly to Sadler.

The announcement of the changes came several days after the surprise resignation of Charles A. Klemmons (retired) vice president of sales, who has assumed E. Walter Thompson Co., New York, advertising firm, which he left one and one-half years ago to return to America. Before joining J. Walter Thompson for the first time, Klemmons had operated his own consulting agency. Before that he had been with American for 18 years.

Blanchard, who resigns immediately as a result of the changing direction of the airline, will remain chairman of the board.

Looked upon as another reason for the part run in the "number two seat" is the company's "lack of apparent" in the presidency. Blanchard sought and could won recognition of his action in the direction of his department.

That was evident when, shortly after resigning American, he took a strong stand against the midwest penalty plan which American, including C. R. Smith, and the rest of the railroad industry, had proposed as a means of reducing railroad passenger rates. Blanchard remained American to make its position on the issue and the plan was eventually killed after it lacked the minimum backing needed to adopt such resolutions within the framework of the Air Traffic Control Act.

The vice presidents now reporting directly to C. R. Smith make the revamped management structure as William M. Hagan, executive vice president, finance and planning, O. M. Miner, executive vice president, marketing planning, George A. Strohs, executive vice president and general counsel, C. W. Fend, executive vice president, public affairs, and Wolfe Price, vice president, public relations.

In announcing the plan, C. R. Smith

and that the senior members of management will also be able to concentrate on long-range planning and at the same time, their experience will be utilized in the younger offices who are charged with the day-to-day conduct of the business. American close to Blanchard in director of airline passenger service.

In 1956, while serving as director sales manager in Buffalo, N. Y., Sadler was a sales executive that attracted the attention of management and won him a position in American's New York headquarters in director of airline passenger service. In 1957, he was elected vice president, customer service.

C. R. Smith and that one of the prime purposes of the reorganization is to make certain that the company is growing in a way management, employees and stockholders can appreciate. He said the position is designed to help develop the "most efficient and capable" people in American for the management of tomorrow's business is going to require increased responsibility today.

He said the change in the management structure results from a continuing study to determine how the airline's general office management as well as the field organization can best be established to handle today's business and prepare for the future. He added:

"We are in a growing business, one in which the techniques continue to change. We should not remain static in the form of an organization, just as we cannot afford to remain static in the field of equipment we operate."

The American places an increased

City Opposes Third Hawaii Carrier

San Francisco—American's ambitions to develop its West Coast potential culminated with San Francisco's refusal to support additional air service between it and Hawaii as yet, despite the fact that the two cities have long identified the city as the "Garden of the West."

Opposition to San Francisco's move came from Los Angeles, which was based on the fact that traffic rules are under the authority of a third commission, the state between San Francisco and Honolulu. Present annual traffic volume is at 700,000 passengers. The route is now flown by Pan American and United Air Lines. The spokesman said if traffic should grow to 1,300,000 passengers per year, a third route would be justified. United and the Los Angeles city council to increase San Francisco-Honolulu traffic by 1965 to 1962.

San Francisco is supporting authorizations of uncontrolled, competitive services from here to Tokyo via the great circle route and authorizations of American to operate into the South Pacific. The third air route being being to Tokyo by cargo aircraft.

Western Air Lines President Terrell

emphasis on its sales activities as the growing number of jet transports threaten to boost seat capacity and load factor. San Francisco, placing American in 1941 as a travel agent in Nashville, Sadler has specialized in traffic and sales.

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Western Air Lines' plan of the three, being conducted by CAB Executive William J. Madden is expected to last for two weeks. Washington place, at which airlines will present arguments on their own behalf, will begin Dec. 1.

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IATA Will Ban Manufacturers From 1960 General Meeting

Washington—Transport manufacturers of five nations have been banned from the 1960 annual general meeting of the International Air Transport Assn. in Copenhagen by the association's executive committee.

This action taken by the IATA executive committee at the recent annual meeting in Tokyo (AW Oct. 26, p. 19) was reviewed in a letter from William Dohmen, IATA director general, to the U.S. Aerospace Industries Assn., the Society of British Aircraft Constructors and French, Dutch and Canadian manufacturers who had spoken at the Tokyo meeting.

Relations between IATA and the manufacturers during the annual meetings have been a source of friction for the past five years. Sir William's letter made it clear that IATA was not objecting to the annual entertainment program offered by the manufacturers during the annual meetings but to manufacturers' contacts with airline officials by manufacturers during the intervals between IATA business sessions. Consequently, the manufacturers were being asked not to come to Copenhagen during the annual meeting there next September.

Sir William noted that he had originally wanted the manufacturers in 1957 that their entertainment programs were in line with the objectives of the annual meeting and that subsequently the manufacturers had cooperated in this regard at the New Delhi and Tokyo meetings by confining to a minimum their contacts with the airline officials.

"In light of 6th December, 1957, did not make the practice of the presence of manufacturers at the place of meetings?" Sir William wrote AIA and SBAI. "I hoped and believed that the presence of manufacturers would give us no difficulty as long as there was cooperation in the practice of entertainment between the airline and the manufacturers at appropriate times in necessary."

"Unfortunately we most recognize that these hopes have not been realized. In this connection the manufacturers have given me no particular difficulties," wrote Dohmen. AIA presidents found they could not contact the hotel lobby without being accused by manufacturers' representatives. When they wished to speak amongst themselves they found they could not do so, and they questioned whether the annual general meeting was the appropriate time for contact with manufacturers

in case manufacturers asserted that they had not received this conference without manufacturers and sealing and with some initial difficulties. However, this could not avoid the unavoidable conclusion that only on this basis would the annual general meeting suffice its practical objectives."

Some IATA members objected to the use of some manufacturers' delegations at the general meeting, since some of which were from times the sons of the largest airline group, and the manufacturers' position for a gathering of meetings in local events they so much the price and the costs of the manufacturers' delegations was actually increasing the risks costs of transports which normally could be passed on to the airlines.

Some manufacturers feel the entire program's decision has been influenced by a consistent antipathy of IATA staff in Montreal to their delegations. They point out that IATA was glad to have them finance entertainment at annual meetings when the host airline was under financial strain but, now that the position has been solved, they feel IATA is trying to push them out of the picture.

Brannif 707 Service Set for December

Dallas, Tex.—Brannif International Airlines will inaugurate daily Boeing 707-227 "El Dorado Super Jet" service on Dec. 20, with the initial flight leaving New York via Dallas at 10:45 a.m. local time, enroute to Brannif's hub base, New York, daily at 9 a.m. EST and arrive at Dallas at 10:45 a.m. CST. It will then make a Tokyo Change flight to Japan at 12:35 p.m. and arrive at 4 p.m. and leave Okinawa at 3:15 p.m. and arrive in Dallas at 5:05 p.m.

Brannif's delivery of its first 707-227 next month, Brannif will get the resources of its engine of intercontinental route. The March 9 transport is powered by four 15,000-lb thrust Pratt & Whitney JT3D-3 turboprops providing approximately 3,600 lb thrust each. Since the JT3D engine on earlier 707s Brannif will eliminate need for water injection during takeoff, eliminating the heavy weight imposed by earlier model 707s.

Brannif has leased a Boeing 707 from the American Export Lines for use during the Dallas base to adjust the base's daily air mail delivery until the arrival of the first of the airline's four engines in the fall (AW Oct. 26, p. 45).

Brannif has ten aircraft in go over the 57 aircraft goal of revenue jet set for 1959—so 1960 it is setting a quota some 25% higher, with a target of more than \$100 million in revenues.

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Convair 880 Jet Transport Fill Production Stations

Convair 880 jet transports are being sent to field operations to be used for airline delivery at the rate of one per month. Above, all six aircraft in Convair's first assembly building are occupied with 50% in various stages of construction. Convair has boosted production of off and forward freight services to three per month as a step toward increased delivery rate—two a month in January, four a month in April and six a month starting in July. Convair 880 series entry into production next February.

Swissair Schedules DC-8, Caravelle Runs

Geneva-Swissair personnel, alerted to short-lead spring, are ready to May 15th, date for its first Douglas DC-8 and Sud Aviation Caravelle runs to London. On alternate days, the flight to Rome will go via Milan. The direct flight from Geneva to Rome will take 1 hr 25 min, instead of 2 hr 20 min, which is the flying time of the Convair Metropolitan then serving Rome out of Geneva at present. This considerable difference in flying time on this route is accounted for by the time required for the Convair to climb over the Alps en route to Rome.

First DC-8 is scheduled to enter service May 4 in three three-to-four flights on the North Atlantic between New York and Zurich. Second DC-8, to start service on June 10, will permit the airline to raise its frequency on the route to six flights per week. These DC-8 will be Aug. 1 service date will be used to increase the frequency still further, working between nine and 12 total flights across the Atlantic with the three-plane fleet. Four of these flights will go via Lisbon.

Swissair's Caravelles, flights will start on May 15. First Caravelle then coming into service will be three hours and a half from Zurich to London. Flying time will be 1 hr 35 min, thus cutting the time required by the Convair Metropolitan aircraft at present to service on this route by 30 min.

On July 1, Swissair's second and third Caravelles will start operations on the Middle East route. This will be three times a week from Zurich to Tel Aviv, monthly via Geneva, Cairo, Istanbul and Ankara will be served twice weekly and

there will be one flight a week to Beirut, Damascus and Tripoli.

French and long-haul Convair to go into service with Swissair will start April 15, using a 737 with a flight distance Geneva-Rome-Cannes-London. On alternate days, the flight to Rome will go via Milan. The direct flight from Geneva to Rome will take 1 hr 25 min, instead of 2 hr 20 min, which is the flying time of the Convair Metropolitan then serving Rome out of Geneva at present. This considerable difference in flying time on this route is accounted for by the time required for the Convair to climb over the Alps en route to Rome.

CAB Notes F-27 Effect

On West Coast Subsidy

Washington—Effect of West Coast Airlines' Panhandle F-27 turboprop operations on the regional's subsidy needs was raised by the Civil Aeronautics Board in an order proposing the grant of an additional \$5 million in subsidies, payable to the carrier for past and future needs.

Back of the estimate in West Coast's transportation cost rates was \$1 million for future operations over a one-year period, starting from August of this year, with the remainder covering a past period from December, 1956, to August

1957, was cited by the Board in its show cause order at \$440,000 less than that originally requested by the airline.

While agreeing that the carrier's subsidy requirements have risen to the demand of \$1.27 million in 1958 and recent route awards, CAB noted that West Coast's request for \$1.5 million seems absurd for the year ending Aug. 31, 1959, than that collected in the previous year, even with the introduction of F-27 service.

Noting the considerable "sense of great concern," Board members added that "we do not yet have sufficient accounting experience to determine whether the new equipment has been phased into the carrier's operations officially and completely." Pending this information, we reaffirm our previous statement as to the lesser responsibility of management to guard against rapidly increasing a carrier's subsidy requirements while considering to new equipment.

Additional subsidy asked for past periods by the airline was rebuffed, the Board said, as a safeguard against the possibility of an excess went a carrier's final rates are established. West Coast's request for increased subsidies, for the future eleven period was reduced to reflect the airline's assumption of service to San Francisco, Ketchikan, Alaska, pending completion of adequate airport facilities.



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Financiers Urge New Local Service Plan

By Robert H. Cook

Indianapolis—Adoption of a new class of tax-exempt bonds for local service carriers was urged last week by financial specialists who cited the proposed CAA 3 Airlines Board plan as the most promising avenue of attracting new expansion capital for the airlines (AWW May 25, p. 41).

Reviewing the current financial picture, a quarter of a century old, of the Airline Loan Transport Airlines long-term bank and investment banks, officials generally characterized the past ten salary payment formulas as so "tight" that investors hesitate to become involved with advances unable to offer some concrete assurance of their expanded earnings level.

Edmund M. Blair, managing partner of Wilkins Blair Co. of Chicago, said that while the first growth of the local service industry is superior to many larger industries and follows a pattern sought by investment bankers, the problem of placing loans and selling stock for the carriers is complicated by their poor earnings history and their subject to stringent government regulations.

Growth Rate

Blair said the local service carriers have attained an annual growth rate of 23% based upon revenue, passenger carried, as compared with annual commercial aircraft growth rates of 24% for International Business Machines Corp. and 12 to 15% for Minnesota Mining & Manufacturing Co.

He indicated, however, that this selling point has been of little aid to the carriers, most of which are still operating under the present compensated and charged system, because the rates are subject to constant revision.

A number of leases and stockholders, Blair said, feel it wise to wait until the subject of phased open debate final staff rates confirming a predictable earnings level. Satisfaction of the CAB's class and rate formula, currently guaranteeing a definite subsidy payment for certain route segments and flight frequencies, would have the effect of setting a new earnings ceiling for the carriers, thus curtailing a tolling of "surpluses" on the part of the carriers, Blair said.

Supporting this view was Robert H. C. Page, president of the Chase Manhattan Bank of New York, told ALTA members that it is "absurd" that local service carriers should be allowed to run their own business. Stock offerings by the carriers thus far are the lowest since 1953 and are them-

ving the credibility of both term and mortgage lending, he said. Adoption of the class rate formula, Page said, would be signaled by banking circles as an adequate knowledge of a definite return on which equity financing could be sold to improve carrier debt/equity ratios in line with lender desire calling for a more balanced ratio than presently enjoyed by the carriers.

Agreeing with this, Hart said that the airlines that are able to offer more favorable debt/equity ratios may be able to obtain funds for leasing or equipment programs such as VTOL aircraft.

Donald B. Harris, president of Avis Rent-A-Car Services of New York, concurred in the need for the class rate plan in a means of clearing up the "taggy atmosphere" surrounding the present and rate rebates formula. For investment purposes, Harris said, the carriers would then be able to show that they are new route undertaken to which would not be opened at a loss.

In the meantime, Harris and local service officials are seeking to amend equity capital requirements to reflect growth through either the Gurnee Ford Loan Act or the equipment trust legislation which has the effect of making loans required by aircraft creditors more attractive to financial sources.

Aircraft purchased under the latter legislation, he said, would be required under a type of "new payment plan" CAB spokesman, he added, has indicated that planes purchased in this way will be compensated as an offset investment for all rebuilt and rate making purposes, with the equipment required being owned by the carrier from the inception of the transaction.

Long-Term Lease

As another alternative, Harris urged that the airlines should explore the feasibility of long-term lease contracts with no option to purchase. While the CAB has not recommended straight leases of aircraft as an investment for subsidy and rate making purposes, Harris said that a property or equipment program of this sort has been presented to the Board. He urged that such action be taken by ALTA on the

ALTA Survey

Indianapolis—One of local Transport Airlines has voted to authorize a detailed study of the local services rendered by the members. What will be done is the Fremont Knobell Corp., of Los Angeles, and is scheduled for completion in early 1960.

proviso that CAB might approve this under a long-term view in more than where neither the government guarantees nor the equipment trust treatment would be practical.

In actual practice, Harris said, the equipment trust legislation would prevent most of the bond issues, preventing that preventing the action of the lender who would have a first call on the assets of the carrier. Most favorable application of the trust certificates, he said, would be those outright sold to the public—a process difficult to carry out with the airline because of the local service "sovereign loan" situation under the present subsidy rules and the hope that a class rate will obtain, plan, which Harris said, might open the way for public financing through equipment trust certificates.

Local Service Financing

Hart and Page both questioned the use of local service financing through the method of equipment trust funds. Page said that the funds, limited with their customary short-term structure of accounts loans and would not be interested in equipment certificates, through insurance companies, which will lead beyond a seven-year repayment period, might be interested.

Blair pointed out that while such certificates have been held for up to 25 years for railroad rolling stock, the certificates sold mostly covered bonds which change little in value. Selling such certificates to cover during nine years time undergo many design changes, he pointed out, it is more difficult.

One of these certificates by the insurance companies, he said, is the stop-gap measure, Blair said, and local service carriers ultimately will have to go to insurance companies for their debt financing because of airline depreciation schedules and whether of the banks to extend financing from beyond a 10-year period.

Selling Stock

Question to carrier representatives as to whether listing of local service stock on the New York Stock Exchange would help ease financing problems was answered by Blair, who said that most trust companies refused to buy such stock not owned by the exchange. He added, however, that the carriers should do better to sell stock to the investment market until they have a large number of stockholders. Listing on the exchange no cash, without enough stockholders, tends to make the stock, Hart said, to a point where it is

regarded as an "explan" by aviation, he said.

Pope advised another questioner to ignore any thoughts of a straight base arrangement or reference alone on the grounds that losses are not assessed in "explan without engine." Pope said such an arrangement, which is now being explored in American Airlines' losing ALTA, will keep captain for the Lockheed Electra, generally can not be applied to local service carriers with limited financial resources.

ALTA also issued a report from Joseph P. Doyle, head of a Senate Interstate and Foreign Commerce Committee subcommittee on transportation. Doyle said he had a number of questions from the commissioners that the transportation agency has given special regard to the scope of its work. Doyle told ALTA that there is an definite deadline for completion of the study but that the group will submit an in-house report to the Senate on Jan. 31, the original date set for a full report. Current problems are that of collecting sufficient information, and Doyle asked the members to submit their problems in detail, along with ideas as to how to improve the studies and the resulting budget alone.

Oring a call for better coordination between ALTA and the transportation, Doyle and his group, however, recommended, which will probably acquire congressional hearings on the need to eliminate duplication and waste in the entire transportation industry. Some quarters find, however, expressed a fear that extensive government regulation is leading to automation of the overall industry and the study group will aim at stabilizing federal programs for regulation in an effort to combat duplication and separate legislative from executive effort.

If no government panel does nothing, ALTA and its congressional group will recommend that they be "scrapped out." As an example, he said that the 17 member group will explore the need for additional economic transportation, the separability of federal and local agencies and whether federal acts are hindering this segment of transportation.

Senate will be a "preliminary part" of the study, Doyle said, with the problem of service into smaller cities and railroad versus air facilities getting thorough attention. The group does not expect to explore carrier complaints about Military Air Transport Service transport of commercial traffic, Doyle said, since it is not covered under the Senate group's authority, but it will investigate proposed and changed rules involving a tax incentive on aviation fuel.

Mail Program Stalled by Dispute

Washington.—Plan for an air mail program to expand the network of facilities used by air (AW Nov. 16, p. 45) met a setback last week when the Post Office Department and airlines failed to agree on accepting certain temporary or interim dual rates.

An attempt to make an agreement that would permit the Post Office to begin earlier with the expanded program while final rates were being determined by a Civil Aeronautics Board rate proceeding was made at a joint meeting between the CAB hearing Examiner, Fred W. Weller.

In the absence of a rate agreement, it is doubtful that the Post Office will offer, or that the airlines will accept, any more than the limited amount of dual-rate mail currently being moved between a few cities until the proceeding is finished and the final rates determined.

A decision probably cannot be reached until late next month.

Weller has set Dec. 15 as the deadline for an exchange of information in specific for 15 cities for exchange of direct airmail, and Jan. 15 for exchange of regional exhibits. Hearings will begin Jan. 25.

Against大陆航空, to an agreement appears to be the Post Office Department's first stand against accepting either a temporary rate subject to a maximum adjustment or an interim final rate for a one-month period which could not be subject to retroactive adjustment.

Such action could actually result in a revenue reduction because current dual rates would be suspended by temporary rates that are not acceptable to the Post Office.

There is a possibility a compromise may be worked out, airline representatives said, if the Post Office will consider softening its stand. One proposal suggested was one which Post Office representatives agreed had some merit, in that the Board issue an order expediting the rate adjustment, but which maintained the maximum experimental program. Under the proposal, a greater volume of mail could be moved to a greater number of points at current rates until the proceeding is completed and new final rates are established.

The Post Office Department and ALTA, however, that a temporary rate subject to retroactive adjustment is unacceptable because of the magnitude as to the total cost of transporting first class mail by air during the period the final rates are being determined. The department said a decision to adopt this type of rate cannot be made until mail is known in advance of operational changes.

The Post Office Department also said that, under its proposed interim final rate, it would not plan to make use of the air mail on a regular basis. Nor will it accept any rate for the transportation of first class mail for an amount of less than 15 months. For a period of less than 15 months, Airlines did not agree to cover the period for that length of time, because they said that in effect, it would set a

final rate for a period longer than it would take to complete the rate.

While a majority of the carriers' representatives and the Post Office would accept a somewhat interim rate as proposed by the CAB in its dual rate order (AW Oct. 16, p. 35), others offered strong objections to parts of the order.

Biggest objection to the interim rates issued by carriers was directed at the terminal charges which that and should be set the same in all handling of air mail. Terminal charges were set for some in one month, some of the largest and most expensive they would probably accept, the terminal rates of \$3.75 discussed as final rates for the six-month interim period.

As a result of the stalemate, no action taken by the CAB to establish either a temporary or an interim final rate pending outcome of the mail problem would not have much effect in getting the expanded program under way. The Board could, on the other hand, issue rates prohibiting temporary rates subject to retroactive adjustment, pre-ferred to the carriers. However, even in the absence of obstruction, it would not form the Post Office Department to make greater use of the airmail in the transport of first class mail.

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SHORTLINES

Allegheny Airlines reports that its traffic figures for the first 10 months of 1959 have surpassed those recorded during the full year of 1958. Passengers increased 10.1 percent over the 1958 total to 489,725. Revenue passenger miles were 20.2 percent higher than those for last year at 83,482,500.

The Babcock Co., Inc. has sold an Douglas DC-6 transport owned by Scandinavian Airlines System to Aerovias de Mexico, S. A. The contract includes spare parts and pilot and ground crew training programs, with delivery scheduled to begin this month.

Chicago Helicopter Airways has agreed to buy a major share of ownership of Sikorsky S-55Cs at its Chicago maintenance base. First flights, with 1,000 hr. of airline service, is the first S-55C or airline service to be overhauled.

Eastern Air Lines has filed a tariff with the Civil Aeronautics Board to reduce fares between Miami and San Juan, Puerto Rico, from \$15.75 to \$17.00 each way. The new fare, subject to Board approval, would begin on Dec. 11.

Federal Aviation Agency has extended the deadline for submission of requests for federal aid for the continuation of airports for fiscal 1961 from Nov. 30 to Dec. 15, 1959, with an extension of the fiscal 1961 program act for the end of the year.

FAA also plans to test a British FMS radio altimeter, the 30-31 transonic model by Standard Telephones & Cables, this winter for possible application to automatic weather-landing systems. Initial tests will be made to determine the altimeter's accuracy, the control altitude of 200 ft. or less.

Northeast Airlines plans to extend its Union submarine reservation system to 11 cities in its system by January. The system, now used at Metropolitan's St. Paul and Chicago, will be expanded to Atlanta, Tampa, Pittsburgh, Buffalo, New York, Detroit, Milwaukee, Spokane, Portland and Seattle-Tacoma.

Military Air Transport Service last week reported the issuance of new interim rates amounting to \$55,817.50 for the transport of Air Force and Army personnel. They are Alaska Airlines, Inc., 51,311; Hawaiian Airlines, Ltd., 52,949; Overseas National Airlines, Inc., 53,097; Rock Island, 50; Shick Airlines, Inc., 54,350. The maximum tolls are \$43,581.

AIRLINE OBSERVER

United Air Lines is currently evaluating Sud Aviation's Caravelle high-speed transport for use over medium-stage routes. Two United test flights are set at Toulouse, where the Caravelle is built, starting the aircraft in about a month. First flight is scheduled for Jan. 19, 1960. Revenue passenger miles will be 20.2 percent higher than those for last year at 83,482,500.

Watch for an early move by Braniff Airways to convert five Convair 440s to Allison turboprop power using the PGE-D13 engine (AW Oct. 12, p. 37).

Frontier has issued a special routing of the International Air Transport Association beginning today in Peru. With air service now serving the South American route, west coast has been shifted to normal route, bypassing local fuel distribution before breaking into power. To meet this challenge, some routes have dropped fares 44.51% below standard rates. Meeting was prompted by Argentina's complaint against this practice. If agreement is reached at the special session, mid-routes will be converted to the new standard rates.

Aeroflot, Soviet state-owned airline, reports that Tu-104 jet transports are carrying 48,000 passengers monthly on the Moscow-Levigrad route alone. Since start of the passenger-type jet services between Russia's two largest cities last April, total air traffic on the route has climbed over 1,000%.

Plans by domestic airlines to work out an arrangement with the Defense Department for the use of seven Air Force and Navy transports for the training of pilots as turboprop transports will fail. Defense Department has told the carriers that the aircraft requests expected are not satisfactory for post use because of high design weight and proposed life-almost hours which could be used for civil training. The alternatives will be rejected by the carriers.

Long John and Imperial have announced the organization of a United Arab Airlines, which has been proposed as an international air transport company capitalized with an initial \$45 million at a commercial air fair in association of the Arab League (AW Nov. 9, p. 56).

Domestic transline traffic volume continued an upward trend in October, although the increase fell short of the spectacular jump in average passenger miles recorded in September. In addition, a sharp rise in available seat miles was recorded, and the number of passengers per available seat mile per aircraft, the ratio of passengers to the total number of passengers, increased further down to 89%. The 60% level since February, individuals, mark-ups operating jet began to experience profit declines in jet load factors as competition increased. Domestic passenger miles for October reached 27.1 billion, a 13% increase over the same month of last year. In September, revenue passenger miles showed a 10% increase—the largest monthly increase since July, 1957. Available seat miles for October were up 15% compared with a 9% increase in September.

Chances are strong that airlines now operating from Detroit's Willow Run Airport will decide to transfer to the newer Detroit Metropolitan Airport to the local control board that began when American Inter-fair joined the Northwest, Delta and Allegheny in 1958. Detroit will be open later this week. Increasing air traffic would force the private airport to about \$8 million for the construction of hangars and \$2.5 million for fuel storage facilities. Airlines now contemplating transfer are studying a plan proposed by Wayne County for a \$15.5 million expansion program for Metropolitan.

Silvers Belgian World Airlines has taken out a \$20 million credit toward the purchase of four Boeing 707 jet transports with the Export-Import Bank and seven U.S. commercial banks.

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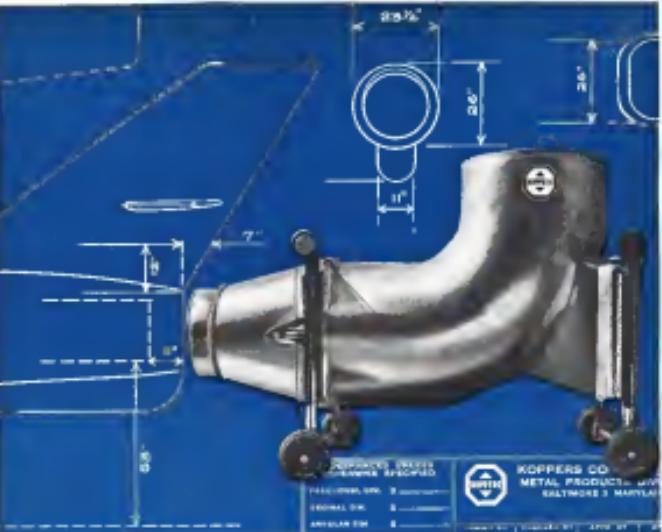
First photograph of the Canadair Forty Four, taken September 20, 1959 in Montreal. The "Forty Four" is now on the line for Pan American, Western Airlines Inc., The Flying Tiger Lines and the Royal Canadian Air Force.

CANADAIR UNITED MONTREAL CANADIAN SUBSIDIARY OF
GENERAL DYNAMICS CORPORATION

Airline Income & Expenses—3rd Quarter, 1959

(IN MILLIONS)

	Passenger Revenue	M. S. Rent	Property	Other	Federal Taxability	Total Operating Revenue	Total Operating Expenses	Net Income Before Taxes
DOMESTIC TRUNK								
American	82,160,172	1,487,203	7,769,100	173,381	782,400,723	82,160,172	44,618,832	
Brussels	14,595,107	404,107	420,400	93,155	14,171,509	14,595,107	—	—
Continental	12,440,291	2,140,291	380,000	126,315	12,343,291	12,440,291	—	—
Delta	22,275,198	495,216	1,415,800	65,821	22,442,173	22,275,198	1,161,268	
Eastern	46,345,820	1,124,820	2,615,436	128,747	49,345,820	46,345,820	4,999,597	
Frontier	1,100,100	1,100,100	200,000	21,200	1,100,100	1,100,100	—	—
Northwest	7,842,712	151,420	210,771	1,281	8,204,716	8,164,844	—	—
Southwest	21,345,458	345,458	1,645,400	24,059	21,750,458	20,419,077	3,330,382	
Twa World	72,315,820	1,354,820	5,081,200	308,123	77,726,820	68,056,703	3,670,116	
United	76,422,616	2,267,616	6,164,000	272,474	80,346,616	74,577,149	5,769,469	
Western	15,442,721	2,242,721	2,000	14,122	16,237,721	15,277,986	9,024,634	
INTERNATIONAL								
American	1,229,004	18,100	1,611,000	—	1,795,004	1,437,245	358,759	
Brussels	1,716,100	48,100	195,000	—	2,254,100	2,110,500	138,600	
Czechoslovakia	221,045	8,172	25,763	42,302	221,045	216,650	17,394	
Delta	1,344,670	10,028	24,264	193	1,646,670	1,391,959	25,711	
Frontier	7,171,200	67,200	200,000	200,167	8,194,200	8,059,300	135,800	
Master	444,210	—	16,000	—	474,210	436,384	37,826	
National	880,540	81,000	48,576	4,193	1,230,540	972,422	26,718	
Northwest	7,779,232	1,426,232	1,260,323	92,107	11,046,232	9,140,206	1,901,499	
Pan American	7,779,232	1,426,232	4,200,000	8,190,000	11,046,232	9,140,206	1,901,499	
Trans World	1,322,244	46,107	133,170	383	1,397,244	1,447,886	—	—
Alitalia	43,676,844	3,059,103	4,767,365	706,016	65,846,844	60,744,844	5,102,400	
Latin American	31,545,000	579,589	4,167,167	204,207	37,128,000	37,357,234	—	—
Pan American	38,174,023	1,720,174	2,150,150	7,764,873	56,023,023	55,586,849	4,436,174	
Passenger	—	—	—	—	—	—	—	
Boeing	272,407	—	429,417	—	692,407	616,322	—	—
Boeing Corporation	272,407	—	429,400	—	645,407	499,800	—	—
Boeing Model	16,185,793	1,014,200	6,027,709	24,000	20,200,793	19,840,000	360,793	
United	2,481,000	16,100	81,100	—	8,733,000	8,116,000	617,000	
Western	1,148,650	12,100	24,073	—	1,294,650	1,036,748	157,908	
LOCAL TRUNK								
All American	3,254,943	15,411	113,070	7,324	3,793,943	3,182,108	—	—
Alvaro	782,523	8,440	58,000	37,191	827,523	1,026,000	—	—
Baron	1,100,100	22,308	26,144	18,542	1,318,100	1,327,314	9,800	
Boulder	1,100,100	22,308	26,144	18,542	1,318,100	1,327,314	9,800	
Latin Central	783,260	16,014	28,157	7,840	449,412	1,295,000	1,345,886	44,409
Midwest	3,113,720	22,016	72,673	20,740	300,379	2,795,000	2,479,838	29,732
Mississippi Central	3,464,403	46,167	140,770	37,100	1,115,403	4,095,748	4,359,343	—
Spark	1,467,413	48,263	166,707	6,003	824,208	2,381,322	2,714,810	147,382
Pan Am	—	—	—	—	—	—	—	
Pan American	3,001,000	10,104	70,010	1,57,104	1,102,711	3,348,945	2,500,800	299,399
Trans World	1,227,207	32,443	27,104	22,008	1,227,207	1,227,207	—	—
Trans-Canada	1,227,207	32,443	27,104	22,008	743,073	8,125,645	—	—
West Coast	1,169,360	18,100	94,475	8,449	419,360	1,977,491	2,322,846	—
REGIONS: LINES								
Alitalia	1,183,100	4,127	24,143	500	1,393,445	1,195,840	148,547	
West Coast	1,732,407	7,003	218,418	212,787	2,207,747	2,142,310	—	—
CAIBO: LINES								
Aerovias Del Alantico	318,310	—	32,328	—	374,310	344,849	19,464	
Brilliant	55,061	—	4,217,507	—	8,279,061	7,434,931	847,030	
Brussels	6,323	1,000,000	107,219	—	8,380,323	1,021,947	328,016	
Scandinavia & Workers	—	—	—	—	2,644,107	8,470,963	201,618	
HELICOPTER LINES								
Chicago Helicopter	342,715	9,601	1,254	700	440,715	405,564	47,151	
Los Angeles Airways	87,843	25,410	26,278	437	232,214	238,854	163,263	
New York Airways	356,335	50,303	18,185	18,185	511,491	446,410	987,194	11,876
ALASKA AIRLINES								
Alaska Airlines	850,764	125,919	105,644	250,248	107,497	2,318,128	2,374,219	24,356
Alaska Central	34,345	34,345	34,345	34,345	127,151	127,151	—	—
Frontier	34,345	34,345	34,345	34,345	71,614	228,569	392,000	35,716
HHS	337,689	11,021	35,437	17,404	81,021	339,163	312,399	—
Northwest Consolidated	2,100,000	74,442	223,487	2,107	301,000	3,275,487	5,064,386	1,385,385
Pan American	850,355	105,100	46,359	46,359	793,000	316,359	296,297	
West Alaska	231,523	70,267	137,038	121,028	123,723	1,478,476	7,419,733	—
* Not available.								
Compiled by AVIATION WEEK from data reports to the Civil Aeronautics Board.								
Northwest—Non divisional transporting income \$203,422—airline before taxes \$203,422—net income \$203,422								



Hilton, IATA Members Dispute Credit System

Washington—Credit and tariff between the airlines and independent credit card firms used to the Civil Aviation Board as members of the International Air Transport Association by IATA Credit Corp. caused the airline members of their credit system.

Hilton urged the Board to confirm an earlier CAB opinion (AW 01, 26, p. 39) that IATA agreements prohibiting airline members from using any credit cards other than the Universal Air Travel Plan should be disapproved. Testing IATA's "a managerial price fixing credit," Hilton and the agreement plan's financial backers on the public, claim carrier members a choice to select their own credit plans and amount to a "prior inclusion, but not of established credit card companies and a 'voluntary and flagrant violation' of antitrust laws."

Defending the agreement, 17 IATA members argued that selection of the IATP plan as the sole credit card for members was based upon unanimous adoption by the members with the individual endorsement of each carrier. The airlines contended that a major reason for not adopting an agreement

that would permit use of several types of plan, such as the Hilton Credit Blanche, was that agent's fees would be assessed the carriers. A uniform plan, IATA added, also would assist any joint sales division between members seeking a competitive advantage through an expansion of their programs.

Hilton told the Board the month of the public hearing, the "unjustified \$425 deposit required in the Universal Air Travel Plan system,

which is said, besides the larger airlines but not the smaller members who need the resources of an established credit plan to expand their traffic base. CAB denial of the IATA agreement would force the individual airlines to make their choice of a credit card plan.

The credit companies added that while a carrier might object to working with an unprofitable credit corporation, it cannot under existing antitrust legislation "choose an agent to banish" an otherwise competing plan.

Referring to the antitrust charges, the airlines argued that one antitrust example is that "you can't give the big boys preferential treatment over the little boys." Credit companies warn "hundreds of thousands" of subcontractors are "big boys" and could thus "drive a hard bargain" with the airlines. IATA members told CAB.



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**Dr. Lester Hagan, Manager
Semiconductor Products Division**



Of Motorola's 2,000 engineers and scientists, four out of five work under the direction of Dr. Daniel E. Noble, Executive Vice President. One of the three divisions under his command is devoted exclusively to military electronics; two others provide strong support. Working together, they form a

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Few organizations serving the military today can so rapidly merge diverse technical talents and productive capacities as can Motorola. In these "task force" divisions, under the single command of Dr. Daniel Noble, can be mustered almost overnight for the solution of urgent military-electronics problems. Cross-utilization of ideas and techniques is the certain result.

The success of this flexible organizational structure was again demonstrated by Motorola's part in the development of the Project Mercury Space Capsule. The Capsule's command control receiver, developed

by Motorola's Military Electronics Division, is the first all-transistorized radio receiver of its type available. Thanks to mass transistors developed by the Semiconductor Division and miniaturization techniques borrowed from packaging specialists of the Communications Division. In another instance, Motorola's Semiconductor Division developed the first samples of a new type of electron-beam-piped with important military applications.

In so far marked by a chronic shortage of manpower manpower, Motorola's strategic deployment of its technical resources is an effective answer both in the solution of current problems and in conducting long-range research.

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SERVO VALVES



904HP propellant turbopump shaft spinner (Size of all valves contained) is in use on Atlas and Saturn (H1) engines. Device replaces several valves and tanks.

able to minimize pump size and power requirement.

- Turbines operate most efficiently at high temperatures, speeds and pressures, but turbines are only now becoming reliable which can withstand turbine stress levels at temperatures produced by an efficient mixture ratio of rocket propellants.
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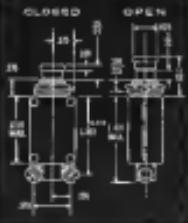
Direct-Drive Pumps

Rockefeller was the first to offer a direct-drive turbopump because of improved pump designs. Measure of how fast a 904HP pump can turn itself is in terms of specific speed, which is defined as the speed which the pump can operate without cavitation. The 904 HP pump can operate at a specific speed of 10,000 rpm and has a maximum operating speed of 10,000 rpm. All 904 HP started at 11,000 rpm and has now been pushed to 13,000. Pump still in research phase has occasionally been pushed as high as 16,000. These improved characteristics have been made largely by design of better inducers at pump inlet to impart velocity before propellant reaches impeller. Specific speed is dependent upon propellants being used, since it is inversely related to set specific speed. Head (total pressure minus vapor pressure of the propellant). Therefore, if a propellant with lower vapor pressure is used, it will cut specific specific speed of the pump. Correct inducer design then becomes critical to the ability to pump any reasonably conceivable propellant including liquid hydrogen.

Rockefeller pumps have progressed from the ML-1 which developed 550 hp, weighed 500 lbs and pumped 1,100 gpm, to the largest current pump which

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OFFICIAL U.S. AIR FORCE PHOTO
of the Atlas 3D-1B at Vandenberg AFB B
on September 9, 1968.
This was the first orbital
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test operational capability.

A memorable event in the Album of Space Technology

Many significant achievements will be added to those already recorded in the chronicles of military and scientific space technology. Many important milestones in the conquest of space will be passed. None, however, will surpass the realization of America's operational capability in intercontinental ballistic missiles. The threshold of this phase of our national defense was passed on September 9, 1968, with the historic launch of an Atlas by a Strategic Air Command crew at Vandenberg Air Force Base, California. Measured by any standard no event could have been more timely... more newsworthy.

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All have worked in concert, with vigor and dedication to the objective of providing the nation with this four-dimensional addition to its defense capability.

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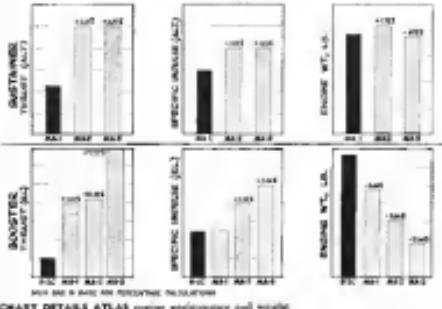


CHART DETAILS ATLAS engine performance and weight.

In a specific application developing well over 50,000 lb. and moving almost 25,000 gal. of propellant fluid per second, it is not twice the size of the ML 1, although its output power is greater by a factor of more than 40. The very nature of propellant power is unique because flow rate must vary directly with thrust, with thrust.

Efficiency Rises

Inthropump efficiency, the ratio of horsepower in the flow to input horsepower, has risen from around 60% in early rockets to about 85% for pumps in current and anti-ballistic boosters. Engineers at Rockwell report that a plateau has been reached in ththropumping efficiency. This, believe conventional approaches to improved efficiency are about exhausted.

In the past, a general trend to shorter specific speed has been to stabilize that flow. The use of a pump with a higher flow density has made it possible to maintain or later pump requirements. When better pumping rates along the nozzle outlet can then cut the surplus strength and weight of the nozzle.

A problem now under attack is that caused by the inadequacies of current heatpipes in deep space because of the harsh environment. Rockwell engineers are considering use of propellant as lubricant for heatpipes and other cooling systems. Through most propellants have significant shortcomings in this application. Another deep space problem is that conventional heatpipes will not survive adequately in the vacuum without air bridges. At least part of the solution will be to cut the number of connections and heat up sparsely packed parts to higher safety factors. Considering the

size of projected vehicles, weight penalty for an 80,000 lb. propellant will be more than much distributed.

While turbopump performance is one of the most important keys to good combustion, it still needs to be coupled with itself to still maintain a highly qualitative rather than quantitative design. Ingress and egress design consists of building and testing small configurations selected by experienced engineers on the basis of formulas which were successful in the past, plus well informed guesses on the influence of new factors such as better fuels. Case hardening should not be made as short as possible to save weight, yet long enough to prevent complete evaporation of the propellants. Hence, quicker combustion allows the chamber to be short and, but the combustion tends to be more unstable. If instability is solved, maximum chamber length is set by the danger of heat transfer into the injector face if combustion occurs too far forward.

Specific Impulse

The combustion combined with exhaust gases of low molecular weight produce high specific impulse. Rocket-dyne engineers have learned that best propellant mixture is one that is high viscosity, a compromise between combustion temperature and low molecular weight of combustion products. With conventional RP-1, a near-eutectic mixture of liquid oxygen and liquid hydrogen, the best mixture is usually the one for which the amount of oxygen is not large enough to consume all the fuel. The remaining part of the propellant, which could be attained with stoichiometric mixture in order to increase the percentage of carbon monoxide and nitrogen in the exhaust and decrease the amount of heavier nitrogen dioxide and water mole-

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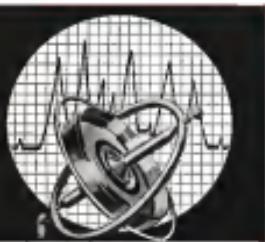
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e. Titanium kathode storage bottles for ICBM Atlas, Titan, which must be vacuum melted, was selected because of its high strength weight ratio, cold-resistance properties and corrosion resistance.

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For These Common-Melting Processes — One of the Crucible processes is VIM — vacuum induction melting. It starts with very high purity raw materials, now fully integrated with it. Crucible led in the development and commercial production of vacuum melted steels, iron, nickel, copper — and titanium. Therefore, Crucible's breadth of ex-

perience, together with its extensive facilities, places the company in the best position to provide the "super-quality" metals most suitable for any given application.

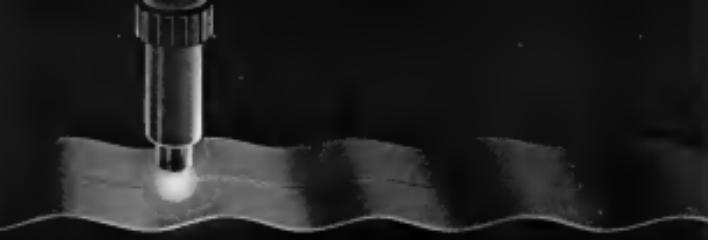
For These Common-Melting Processes — One of the Crucible processes is VIM — vacuum induction melting. It starts with very high purity raw materials, now fully integrated with it. Crucible led in the development and commercial production of vacuum melted steels, iron, nickel, copper — and titanium. Therefore, Crucible's breadth of ex-

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If you'd like to know more about Crucible's work in High-Purity Metallurgy, read: "Quality Aspects and Properties of Vacuum Induction Melting and Vacuum Arc Remelted Steels and Super Alloys" and "Titanium for Aircraft and Spacecraft". Write Crucible Steel Company of America, Dept. AK-17, The Oliver Building, Mellon Square, Pittsburgh 22, Pa.

CRUCIBLE

STEEL COMPANY OF AMERICA



Weld any contour with precise arc control



NEW Airco Automatic Heliweld Head

Get top quality welds every time — even on irregular contours or in restricted areas — with Airco's new Automatic Heliweld Head. With this new design, you're sure of precise arc length control over all surfaces . . . accurate, automatic welding in all positions . . . vibration- and wobble-free operation all the time. What's more, you can set it to weld aluminum (in AC) or ferrous materials (in DC) — or the fact of a choice. Sensitivity is maximized with argon or helium.

The new Airco Automatic Heliweld Head is right at home on the toughest jobs. Internal circumferential seams, for example, are handled

easily with the 3° or 12° offset arms. Tilting mechanism provides accurate, controlled welding through 360°.

Take your choice of two models. Model E takes electrodes up to 1/8", Model D takes electrodes to 7", and is provided with controllable offset arms of 3° and 12°, greatly increasing your ability to weld hard-to-reach spots.

Get full details on the new Airco Automatic Heliweld Head now. Call your nearest Air Reduction Office.



AIR REDUCTION SALES COMPANY

A division of Air Reduction Company, Incorporated
100 East 42nd Street, New York 17, N.Y.

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With metal additive feeds, a higher percentage of welder might be used.

The film cooling of chamber and anode walls with a layer of fuel has been abandoned as unsuccessful since magnesium cooling techniques have been improved. However, it is the customer to use the proper welding slightly more fuel rods than magnesium to reduce heat transfer into the walls.

From the combustion engineers' standpoint, problems posed by the big engines are different in degree after this kind. As the industry strives for higher performance, propellor systems become more sensitive to combustion stability. Since the gas volume in a large thrust chamber has a lower natural frequency, amplitude of waves is greater and higher energy levels in them increase the danger of instability. However, instability has reached the limit of a routine engineering problem and Rocketdyne engineers are so anxious to do their share, to cope with it.

Computer Technology

Rocketdyne combustion engineers expect that improved mathematical tools and greater use of integrated technology will soon eliminate much empirical testing by providing more reliable theoretical predictions. This trend is already being felt and the research organization is beginning to make real contributions in the development phase. Combustion experts also expect more detailed understanding of combustion among hardware designers than was formerly the case. This is indicated by the gradual disappearance of such terms as "flame front" and "expansion zone." It is becoming more clearly realized that if there is such a thing as a flame front in combustion zone, it is warped around the propellant droplets, whose behavior is at the heart of combustion phenomena.

Nickel Tubing

In current thrust chambers, Rocketdyne has used wall tubes of garden variety nickel because of its good thermal conductivity, corrosion resistance, and ease of forming. In advanced systems now being designed, that practice will be stopped and tubes with a higher strength-to-weight ratio will be used. In fact, INCO has recently developed tubes with a strength of 100,000 psi compared with 8,000 psi for nickel.

The tubes which in the big boosters will be forged of Rene 41, cobalt-base alloy.

It is reported to be more weldable than competitive materials and at the temperatures anticipated, it has about the highest strength-to-weight ratio of any material available. For some parts Rocketdyne would like to use



To increase safety at all altitudes...

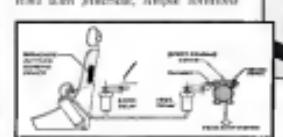
Pacific's

**new EMERGENCY ESCAPE DEVICES
solve Automatic Sequencing Problem!**

When a pilot ejects at high speeds, seat-belt separation is delayed two seconds to prevent injury and parachute opening. However, this delay of two seconds, when applied to family made at extreme speeds, may prevent full parachute opening before the pilot has the ground.

To reduce this delay and to increase pilot safety at low altitudes, Pacific Scientific has developed a Special Ejector and a Parachute Deployer for the Air Force. The Special Ejector is designed to eject seat-belt and parachute in less than 1.25/100 sec. In addition, these two devices permit a three-second delay at high speeds — and high altitudes — thus preventing the correct sequence of automatic seat separation and parachute deployment under any condition.

Both devices are unusually simple, rugged and dependable. And they are designed to permit easy installation on existing equipment or little cost. This is the type of reliable engineering ingenuity Pacific can offer your company — for capability to provide perplexing problems with practical, simple solutions.



Pacific's Survival Seat Ejector (left) and Parachute Deployer (right) are designed to solve the problem of the two-second delay in the correct sequence of seat separation and parachute opening.

If your problem is in materials, instruments or safety equipment, discuss it with Pacific. Do it today!

SCIENTIFIC COMPANY

P. O. Box 22515, Los Angeles 22, Calif.
TELEGRAMS: PACSCI 22515
TELETYPE: PACSCI 22515
TELEFAX: 22515

REPRESENTATIVES:

In the Eastern U. S.: Aero Engineering Co., Atlanta, Ga., N.Y.
In Canada: The General Manufacturing Corp., Toronto, Ontario



Phone 22515





REPORT FROM ARMA

The Missile Train—Mobile Sunday Punch

In the foreground above is the missile train—a hit-and-run Sunday punch for our modern Army. In event of war, the train could fire a missile with nuclear warhead, move rapidly miles away, then fire other missiles ... without becoming a vulnerable stationary target itself. The missile train would be an ever-present threat to the enemy's tactical units over a wide area.

Abbildung, Dogginsense White in E. C. Ladd, *Emp. Supp.*, etwas weiter ausgedehnt als Bild 907 gezeigt.

AMERICAN BOSCH ARMA CORPORATION

ular navigation systems for use in artillery and missile survey, combat vehicles, tanks, and helicopters, as well as remote control types for mine detection and antitank blast survey. Precision navigation systems are ARMA's business from ships to ICBMs and beyond.

ARMA, Garden City, N.Y., a division of American Bosch Arms Corp....the future is our business.

GROWTH of rocket's high thrust liquid propellant rocket engines is detailed above, starting with Redstone up to the 150 000 lb. thrust of the Atlas ICBM.

such biomass but it is a catalyst which initiates decomposition of biomass, and eventually designs its product for easy conversion to storable propellant systems.

Competible Coatings

Coatings that are compatible with steels and high energy fluxes being applied to achieve conventional compositions to provide the widest range of temperature and corrosion resistance. Among the coatings developed are aluminum and aluminum oxides which are fluorinated or plasma sprayed upon the exposed surfaces. These coatings are hard to burn because their lack of ductility and usually have different thermal expansion coefficients than the base metal upon which they are applied. Rutherford has adopted the practice of gradually increasing the cyclic pressure on successive turns to improve adhesion and resist separation of each and base.

"Unstabilized" acrylic sheet, now being sought to reduce demands upon turbo pump or reservoir pressure drop across the injection face, is a challenging materials problem. Increasing use is being found for aluminum coatings with boron fluoride addition. Boronized stainless steel sheet, and plates with thickness up to 17,000 μ to 32,000 μ . Metal seal is required. It may be used with all it is used in vacuum power units.

31 days in March and made possible by

of large thrust with goes out of a \$16-million Air Force-funded Rocket Engine Advancement Program (REAP) which began in 1992 and lasted four years with the purpose of advancing component statistical thrust. Some observers are concerned that a new REAP program would yield results comparable to those obtained in the earlier one. Problems of fast programs were:

- Substitution of analytical thrust

Projects with more than a touch of the unusual. Most U. S. Navy sources have Blue Blot catalogues. Just recently a Blue Ocean banner with both past and present naval history was exhibited. We are sure that the final edition of what will be the world's most powerful radio telephonograph will be assembled in the next 600,000 days from the present date.

Whether you need a complete turn-key plant or just a few pieces of processing machinery, large or small, you'll be sure to get a bid from Bissell.

E. W. BLISS COMPANY

BLISS
SINCE 1959



BUT...

Heating Blankets and other Woven Heating Elements by **SAFEWAY** can make your **COLD** problems **OLD** problems!

Be in the frigid attitudes of which assumed already, the cold, truculent space stations of remote and untold, or the icy Arctic wastes of DEW Line stations — it's always "winter" somewhere.

Environmental temperature problems connote to this kind of "winter" basic faults and latencies and hamper the operation of many types of sensitive equipment.

But **SAFEWAY** deals with problems by packaging **controlled heat** for application everywhere. Among the wide variety of heating blankets and woven-wire

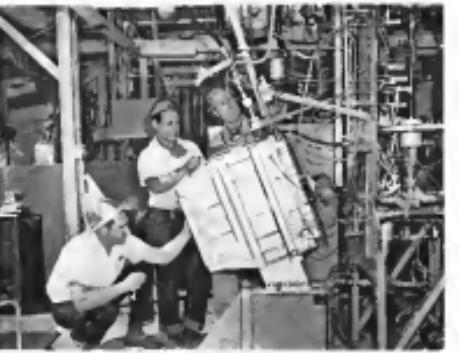
heating elements which have been engineered by **SAFEWAY** to meet existing specifications are:

- **heating elements for insulation equipment and for turbine gyres, cameras, computers, servos and terminals — for missiles and aircraft**
- **heating units for radial surfaces**
- **heating elements for all types of ground support equipment**
- **defrosting units for industrial and commercial refrigerators**
- **heating blankets for hoses/knits and metals-metal bonding**

For your copy of a
fact-filled folder,
please write:



If it has to be heated (and the "it" can be just about anything), you can rely on **SAFEWAY** engineers to study your problems carefully, and — without any obligation — submit an appropriate memorandum.



CAMERAS photograph combustion and fluid dynamics phenomena in this two-dimensional model of a boost chamber. Cameras are in quite numbers at upper end

chamber for thrust vectoring cases.

■ Development of tubular wall thrust chamber to replace double-wall can structure.

■ Adoption of petroleum fuel such as JP-1 in replacement for alcohol.

■ Development of propellant pump jets to work at low mass pressures.

■ Development of a bell-shaped nozzle to get higher expansion ratios for nozzle length than straight expansion cone

■ Bootstrapping turbopump development to replace separate monopropellant system to suffice various of liquid propel first rockets.

Our big advance Rocketdrive would hope for is a new REAP program as a way to produce lighter, cheaper propellant storage tanks.

■ Adoption of carbon fiber-phase propellant system unique originally developed by the Germans in favor of "heat gas" start with immediate operation of full thrust.

■ Adoption in Atlas MA-3 propellant motor and I-11 propellant writers of **Safeway** of fuel premix separated fuel control valves.

Progressive simplification of this fast family of large American liquid propellant rockets over at least as much as grinding detail engineering as it does



Rescue Rocket Sprays Oil on Waves

Used from a drogue-type launcher, the new German rocket is designed for rescue work and sprays a thin film of oil over a 90,000 sq. ft. radius to smooth rough waves. Rocket has a range of 900 ft. and carries one quart of oil which is ejected through small openings in the nose cone and around its center. A shield on the launcher protects the "nozzle" from the hot exhaust. For as the solid rocket (right) are cast to rip it from its longitudinal axis. Rocket was developed by (West) German Rocket Society and is expected to go into mass production next year.

Official U.S. Navy Photograph

From the pioneer in high-performance metals...



REPUBLIC TITANIUM is used in dozens of structural components and details in the Martin D-21 Bomber, including engine mounts, outer skins, and the nose section. Commercially pure titanium and titanium alloy supplied by Republic International, Inc., is used to reduce weight. Republic Titanium Alloys are among the strongest materials at elevated temperatures.



REPUBLIC HIGH-TYPE HEATED METAL POWDER is used for forming of fully drawn components in aircraft and missiles. Powdered metal is heated to 1,200°F. and then drawn at 1,000°F. to 100,000 psi after heat treatment. Less than 204% shrinkage from the wire or 8.8 density. Available in quantities up to and including 12 tons or multiples. Can be used with existing operating equipment. Send coupon for detailed data sheet.

REPUBLIC ANNEALED TITANIUM 380-390—types 381 and 390—are currently being used by Jader Aircraft Company in the Balsam aircraft. These materials are high-purity titanium with a minimum 99.9% purity. They have greater strength, greater heat resistance, maximum corrosion and high temperature resistance. All types are readily formed into desired shapes by the usual commercial methods. Send coupon for complete information.

REPUBLIC STEEL



World's Largest Producer of Missile Metals—Titanium,

TYPE 4130 ALLOY STEEL FINS FOR THE SIDEWINDER

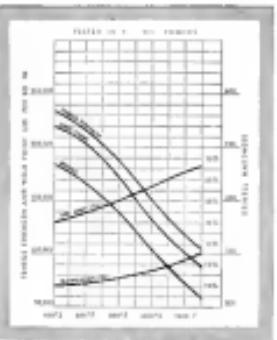
Close-tolerance, definitely contoured fins for the Sidewinder sidewall missile are currently being produced from Republic Type 4130 Alloy Steel by the Sturms Deep Forging Company, Springfield, Massachusetts. Choice of this high-strength alloy, according to Sturms, was dictated by extreme performance requirements.

Republic 4130 offers exceptionally high strength-to-weight ratios with the highest strength values. As seen at right, tensile strength in the heat-treated condition is over 230,000 psi after tempering at 400°F., with a Brinell Hardness of 460. Uniform response to heat treatment assures complete deep-hardening penetrations.

The Sturms Deep Forging Company reports no production difficulties involved in the use of Republic 4130. Fins are produced from bar-rolled 15/16" diameter 4130 bars in successive forging, hot stretching, grinding, wet sandblasting, and coining operations.

Republic has pioneered in the development and production of new steels to resist heat, reduce weight, or increase strength. With constantly expanding research as well as production facilities and capabilities, Republic stands as the nation's largest producer of high-performance metals—titanium, stainless, and alloy steels.

Let us help you find the most advantageous use of these metals in your project. Return the coupon for complete information without obligation. Please indicate if you would like a Republic Metallurgical Specialist to call.



REPUBLIC STEEL CORPORATION	
DEPT. AM-TR-74 1441 REPUBLIC BUILDING • CLEVELAND 1, OHIO	
Have a metallurgist call: _____	
<input type="checkbox"/> Alloy Steel	<input type="checkbox"/> Heat-Resistant Steels
<input type="checkbox"/> Heat-Treated Metal Powder	<input type="checkbox"/> HSM-464 Metal Powder
<input type="checkbox"/> Stainless Steel	<input type="checkbox"/> Stainless Steel
<input type="checkbox"/> Titanium	<input type="checkbox"/> Titanium
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Zip: _____	



MAXIM CUTS NAVY JET NOISE 25-30 DB

Thousands of field tested by an independent acoustical engineering firm, . . . requiring no water even when afterburners are used . . . the Maxim JEM-8 Mobile Exhaust Sound Suppressor reduces jet exhaust noise by 25 to 30 db.

Built for high temperatures, the JEM-8 is a portable, all-metal speaker type unit with a maximum weight of 55,000 lbs. including undercarriage. Engineered for all present types of jet aircraft, it is available with adaptors for various aircraft configurations.

Shown here in use at a naval air station, the JEM-8 will shortly be in use at many other Naval and Marine Corps air stations. A commercial jet version, the JEC-8, is available for pad burning engines.

For noise suppression, consult Maxim — for it is here that it's a science.



JEM-8 with undercarriages retracted for road travel.

SEND FOR PLEADER "JET ENGINE SILENCING"
Emhart Manufacturing Company
Maxim Division, Dept. 78
Box 218, Hartford 1, Connecticut

Maxim JEM-8 Silencer in use at Naval Air Station Pensacola.

to these major steps in technique improvement.

In developing 1.5 million lb. thrust F-1 boosters, Rocketdyne reports no important obstacle in the scaling of its aerospace-qualified facilities is the problem of scale length. Perhaps the most difficult scaling problem inherent in scale is that of obtaining a smooth start for a chamber of such large dimensions. Experience with F-1 indicates that development problems stem from phenomena which can be ignored in small thrust chambers but become serious in large ones. They are there no reason to predict difficulties of different nature from those encountered in the past.

ABMA Schedules Pershing Shots

Orlando-Orbital development flights of the Army-Martin Pershing solid-propellant ballistic missile are scheduled to be made early next spring according to the Army's Ballistic Missile Agency.

Preparations for firing the missile, including the blockhouse and launch complex, have been turned over to ABMA at Air Force Missile Test Center facilities, Cape Canaveral, Fla. The two-story concrete blockhouse, which forms the apex of a triangle with two Pershing launching pads, provides 5,800 sq. ft. of usable space. The walls are one foot thick and steel reinforced, and the roof carries from eight to five feet in thickness.

The blockhouse was designed by Martin II Consulting Engineers, Inc., Martin, and constructed by R. E. Clark Son, Inc., of Petersburg, under the direction of the Army Corps of Engineers and the Martin Co.

In addition to the blockhouse and two launching pads, the area will contain a helicopter parking area, a mess hall, administration building and a service structure.

The Pershing system will have a range of up to 700 mi. and will be given, plane and helicopter transportable.

Missile Capsule TV Will Photo Impact

Army Ordnance Missile Command has developed a television television transmitter to be housed in a capsule carried in a ballistic missile. Capsule would be ejected during flight and, while falling to earth, would photograph impact of the missile. Device would transmit the range of the target area to television monitoring screens at command posts before the screen of battle.



NOW! Automatically Control and Test Complex Electro-Mechanical Systems with complete reliability!

If you're having trouble testing complex electro-mechanical systems, it will pay you to investigate DIT-MCO's 350FIM Electro-Mechanical Systems Analyzer. It specifically designed to control and monitor devices and their associated wiring by sending digital commands and monitoring their action.

Because of the Analyzer's 200 test points you can perform up to 26 independent switching functions. Its capability to control complex systems, therefore, is almost unlimited. In each test another the 350FIM will:

1. Activate all necessary resistive devices and provide testng bus-to-resistor test points of each resistor for continuity and diodes.
2. Stimulate conditions which allow it to operate and test each resistive device in the circuit under test.
3. Provide for visual measurement of resistance values and time delay constants when desired.
4. Provide switching capabilities which enable monitoring of circuit conditions with external detecting devices.

These capabilities make it possible to achieve extremely high standards with complex relay circuits and similar systems, thus eliminating heretofore areas which can lead to malfunction under operating conditions.

The 350FIM uses DIT-MCO's exclusive Matrix Chart to put complete circuit information right in front of the operator's eyes. The machine is easy to operate, easy to interpret, easy to adapt to any test. Write today for full details.

DIT MCO

ELECTRONICS DIVISION
Box 1030, 211 Broadway
City, Calif. 90231

In Los Angeles area 424-2111; in New York City area
212-727-5100; in Chicago 312-222-5100;
in Philadelphia 215-625-5100; in Boston 617-426-5100;
in Seattle 206-467-5100; in Atlanta 404-522-5100.



SPECIFICATIONS:

1. **Capacitors:** Total 25 pFDC
Each individual 0.1 pFDC
Each individual 100 pFDC
2. **Resistors:** Total 100 ohms to 100,000 ohms
Each individual 10 ohms to 10,000 ohms
Each individual 0.2 ohms to 10 ohms
Each individual 0.0001 ohms to 0.0001 ohms
3. **Switches:** Total 200 FET's
Each individual 20 FET's
Each individual 100 resistive
Each individual 0.0001 ohms to 0.0001 ohms
4. **Power:** Total 0 to 200 milliwatts
Average 100 milliwatts
5. **Time (delay):** Total 0 to 1000 microseconds
0.1 ohms, 0.1 pFDC 0.2 second max. duration
Total (1000 microseconds) 100 microseconds
6. **Frequency:** Total 0 to 1000 cps
Each individual 0.1 to 1000 cps
7. **Temperature:** Total -55° to +125° C
Each individual -55° to +125° C
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Since first static model of Project Mantis capsule is positioned (left) in throat of McDonnell Aircraft Corp.'s new wind tunnel at St. Louis plant in closing round circuit. At right, model is photographed as it would appear while test is under way. Wind-tunnel model "Tunnel, capable of measuring airflow speeds to 4,000 mph., is part of \$1,324,900 polysonic wind-tunnel laboratory.

McDonnell Begins Operating Polysonic Wind Tunnel



Close circuit television camera used by a McDonnell engineer to monitor the polysonic wind tunnel from the control panel (left). Another view of the control room is shown below, the control panel and closed circuit television are at right, and data processing equipment is in the foreground at left. The new laboratory contains 36,857 gross square feet of floor area. In addition to the wind tunnel the building houses a thermodynamics laboratory for testing equipment and materials at temperatures from -160°F to 1,200°F.



One of a series of illustrations depicting historical milestones in utilizing communications through the ages.

GLOBAL COMMUNICATIONS - 1815

The Battle of New Orleans

on January 8, 1815 was fought 33 days after the end of the War of 1812. The Treaty of Ghent terminating

the war between the U. S. and Britain had been signed on Dec. 24, 1814. Yet before the static was half drawn,

General Andrew Jackson with his mighty force of frontier militiamen, 500 regulars and a few regulars, over marched east to one

fight and won the memorable victory over Gen. Edward Pakenham's crack 3,000 regulars—victims paid their victory over Napoleon.

This war was but a facet of the large global forces armed by the ambitions of Napoleon and the French Revolution.

The Bettman Archive



Now, the United States is leading the free nations in building a bulwark of defense as man's last stand for world peace in the face of today's aggressive ambitions. In this age of global communication our defense network requires instantaneous Electronic Communications. Within seconds, policy makers and commanders must have knowledge of events, make decisions and give orders. Two-way command and data-link communications, instantly available, is essential for world-wide action in time of crisis.

ECL is proud to be supplying major communications equipment to our armed forces, as surface, air-borne and space applications. Systems such as the air-borne communications and data units linking the latest USAF all-weather Century Series Interceptors into the Continental Defense network are ECL products.



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NEW MARQUARDT HYPERJET

delivers greatly improved propulsion from earth to orbit — and for hypersonic flight!

Imagine missions at speeds beyond those of any rocket — involving smaller and lighter vehicles, longer ranges and heavier payloads than those possible with today's rocket engines. These are missions for the Marquardt Hyperjet.

The Marquardt Hyperjet combines both rocket and ramjet in a single, integrated engine system — providing maximum performance from both. It is an engine optimized in design and reactivity. It is an engine utilizing the ramjet's supersonic specific impulse for acceleration and hypersonic cruise within the earth's atmosphere. From earth to orbit, the Marquardt Hyperjet delivers twice the average specific impulse of today's best rocket engines, permitting heavier payloads at minimum cost. Yet than current, single propulsion system configurations — any other for hypersonic flight within the atmosphere — shrinks both size and weight of the vehicle required to deliver any given payload.

This, then, is the Marquardt Hyperjet: a new generation system with applications to small and large vehicles — national and international — research, and air-launched — for operation in and/or out of the earth's atmosphere. If you have an applicable mission — and the need to know — you are invited to contact: Paul J. Pazarak, Director of Marketing, Power Systems Group, 18555 Stanley Street, Van Nuys, California.

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Executive and Scientific staffs of continuing
reference to individuals better qualified to write:
Manager of Personnel Development, Power Sys-
tems Group, Texas Sales G.M., Van Nuys, Calif.



1952 First to fly a shaft-driven helicopter. **1954** First to fly a helicopter powered by twin turbines.

1956 Helicoil flew the first helicopter to be converted with a new turbine engine specifically for helicopter use.

1958 Helicoil converted its production 100 percent to turbine-powered helicopters, becoming the first major helicopter company to take this forward step.

THE YEARS BEHIND PUT US YEARS AHEAD IN TURBINES



In National Defense **KAMAN** is part of the plan

THE KAMAN AIRCRAFT CORPORATION • BLOOMFIELD, CONNECTICUT

AERONAUTICAL ENGINEERING



CANADAIR CL-41 jet trainer is adaptable to four different makes of turbine engines without structural modification. Royal Canadian Air Force advised and coordinated with Canadair on design, which the covers RCAF and USAF specifications.

Turbojet CL-41 Covers Full Training Span

By Robert L. Stanfield

Medium-fan design details of Canadair's new side-by-side CL-41 jet trainer point to a rugged, flexible airplane capable of covering the full span of student training—from primary through advanced instruction—at speeds ranging from 65-kt (still) to 500-kt (at Mach 0.9 flight level).

The CL-41 will be the first all-Canadian designed aircraft produced by this subsidiary of General Dynamics Corp. It was developed in private venture form in which, from its inception, the company has benefited by advice from the Royal Canadian Air Force.

Airplane will be powered by the 480-lb. (maximum weight) Pratt & Whitney prototype JT17D-2 engine which develops 2,900 lb. of thrust but will be "derated" to 2,400 lb. for the CL-41. Canadair feels that by reducing the power it will provide a reserve margin for the stratospheric flight that 2,400 lb. of thrust there will still be a good power margin plus availability of engine's full thrust and growth potential. JT 12 production engines available next year, will develop 3,000 lb. of thrust, which is expected to net 2,310 lb. by December, 1961.

Canadair also sees the reduction to 2,400 lb. to raise the margin between cruise and critical speed, increase the time interval between cruise and critical speed, increase the engine's initial overheat period to about 500 hr (Pratt & Whitney specifies an initial 600 hr overheat life for the JT17D-2) and reduce the specific fuel flow.

The company will accomplish the power reduction by controlling the fuel flow, via throttle positioning on the engine afterburner. By adjusting the throttle linkage, the engine will be delivering 94% power when the afterburner mode is 80% in the cockpit.

Thrust Rating

At 2,400 lb. thrust—which is both military (still) and maximum continuous (cruise) rating—specific fuel consumption is 44 lb. per lb. of thrust. At 90% normal rating (maximum cruise) and 75% normal rating (maximum cruise) the specific fuel consumption is 320 and 315 lb./hr. of thrust, respectively.

The CL-41 also is adaptable—without an structural modification—for the following engines: the Armstrong Siddeley Viper ASV 11 of 2,450 lb. thrust; the General Electric J65 of about 2,500

lb. thrust; and the Rolls-Royce RB 145 of 2,750 lb. thrust.

Planned to remain at less than 5,000 ft. length the CL-41 in size and weight is comparable to the old piston-engine AT-8 advanced trainer. Span of the jet trainer is 35 ft. 4 in., length is 32 ft., overall height is 9 ft. 4 in. Design and landing gross weight is 6,500 lb. Bay bare the components and

the performance and design features of the CL-41 include:

- Takeoff-limited capabilities. Takeoff distance is 50 ft. per level, is specified at 1,875 ft. Landing distance from 50 ft. sea level, at half-lead, is 1,970 ft. Canadair says the CL-41 will reach (following take off) 600 ft. by the time it passes the end of a 5,000 ft. runway, thus considerably cutting takeoff distance.

- Clean-skin design. Trainer has a clean skin specified at 4,100 ft. (at sea level), 2,000 ft. at 20,000 ft., 1,400 ft. at 30,000 ft. Thus, to climb to 15,000 ft. it starts at 5 min., to 30,000 ft., 11.7 min. Service ceiling is 46,000 ft. Range on internal fuel (plus 10% reserve) is 800 nautical mi., with underwing tanks, 1,050 nautical mi. Maximum speed level speed is 472 ft./sec. (true air speed).

- Clean-skin design. Trainer has a clean skin specified at 4,100 ft. (at sea level), 2,000 ft. at 20,000 ft., 1,400 ft. at 30,000 ft. Thus, to climb to 15,000 ft. it starts at 5 min., to 30,000 ft., 11.7 min. Service ceiling is 46,000 ft. Range on internal fuel (plus 10% reserve) is 800 nautical mi., with underwing tanks, 1,050 nautical mi. Maximum speed level speed is 472 ft./sec. (true air speed).



CENTER CONSOLE (left) contains test instruments and radio-channel selection. Pilot's instrumentation layout is at right.



Canair CL-41 Specifications

Aircraft
 Length, overall
 Width, overall
 Height, overall
 Maximum gross weight
 Max. takeoff gross weight
 Useful load (13,750 lb. max)
 Auxiliary load (less 70-lb. underfloor tank)

Wing
 Span, overall
 Aircraft surface load
 Aircraft section load
 Load factor, max
 Load factor, min
 Flap deflection (10° max)
 Approach

Ailerons
 Total area, left of wing
 Area (sq. ft.) in per cent of wing cross-section
 Deflection

Rudder
 Area in per cent of wing area
 Deflection

Stabilizer
 Protected lateral area
 Deflection

Horizontal tail
 Total area
 Inclination
 Deflection (deflected)

Vertical tail
 Total area
 Deflection
 Deflection (deflected)

Landing gear

Engine

Military rating (tanks)

Military rating (maximum fuel)

Military rating (normal fuel)

Military rating (internal fuel)

18 ft. 6 in.
 18 ft.
 6 ft. 2 in.
 6,000 lb.
 6,000 lb.
 6,000 gal.
 150 gal.

100 sq. ft.
 NASA 100114
 NASA 100115
 1 deg.
 1 deg.
 8 deg.
 8 deg.

10 deg. R.
 40%
 +10 deg.

10%
 10 deg.

40.5 sq. in.
 1 deg.

15 deg. up, 10 deg. down

17.40 sq. ft.
 10 deg.
 +10 deg.

20 ft. 6 in.
 2 ft.
 14 ft. 7 in.

13 ft. 10 in.

10 ft.

15 ft. 10 in.

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10 ft.

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Specific Fuel Consumption
 (lb./hr.)
 (lb./hr. of thrust)

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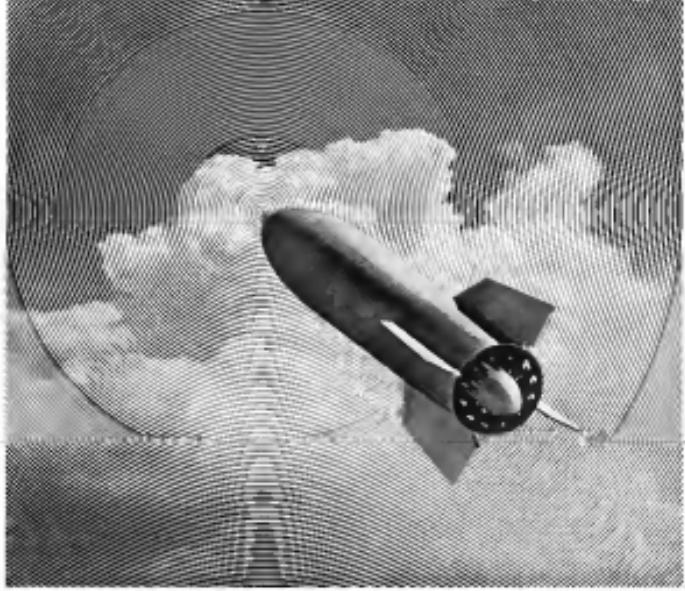
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BENDIX RED BANK ANNOUNCES NEW FACILITIES for research, development and production in Safing, Arming, and Fusing Systems and Components. As systems increase in complexity the need for higher precision in safing, arming, and fusing grows. To meet this need, Bendix Red Bank Division has created a new department exclusively to design, engineering, and production techniques for these vital systems. ■ This "Special Products Department" is staffed by engineers selected for special abilities in that field. Environmental test equipment and precision testing enable swift, accurate transition from design to product. Fresh approaches to design and production problems are encouraged by environment conducive to creative thinking. Performance-proved production resources back up new ideas. ■ Since 1941, Bendix Red Bank has grown from a maker of simple electrical devices to a producer of complex electrical and electronic systems. This is added assurance that here your most complex safing, arming, and fusing problems will receive knowledgeable attention from fundamental analysis through final production.

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SPEED BRAKE closure is at Stop. Deploy guard for engine intake duct (below) is in partially open position. Screen is closed on the round intake when over nose so



semi-monococque, and is constructed from aluminum alloy framed frames, bulkheads and deck, with longitudinal bays underneath and four extended longitudinal bays section, with cockpit major, is detachable. Wing loads are distributed onto the fuselage at least

bulbheads. Vertical fin loads are transmitted by integrating the fin span with the fuselage structure. Boring structure at engine transverse positions carries thrust, with loads from engine.

Category Structure

Canopy structure is of extended and fanned fringed sections and two forward facing panels, hinged at the air end. Pressure seals are attached to boundary frames. Canopy is held in closed position by three hooks in earth sill and is further supported by a ledge at the windward hoop frame. Minimum downward vision over the nose is 10°. Ground pressure is 11.5 deg. Canopy, jetstreamable from either end, is normally opened and closed by an electro-hydraulic actuator, a mechanical standby

system is usually operated.

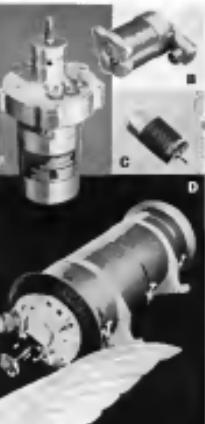
Wing is of a single main spar and trussed skin design supplemented by two auxiliary spars providing attachment for leading and trailing edge assemblies. The three spars and skin panels form a two-cell box structure.

Emergency Features
Torque Motor: 92 inch pounds
torque, weighs 7.2 lbs., continuous duty, 4000 cycles AC

■ Auxiliary Motor: 2.25 HP, weighs 3.9 lbs., intermittent duty, 28 volt DC.

④ General Purpose 0.14 HP., weight 15 oz., continuous duty, 600 cycles AC.

■ Helicopter Prime Mover:
260 HP, weighs 1,080 lbs., can
run continuously, 400 cycle AC



TASK electric motors

smaller package, more power per ounce

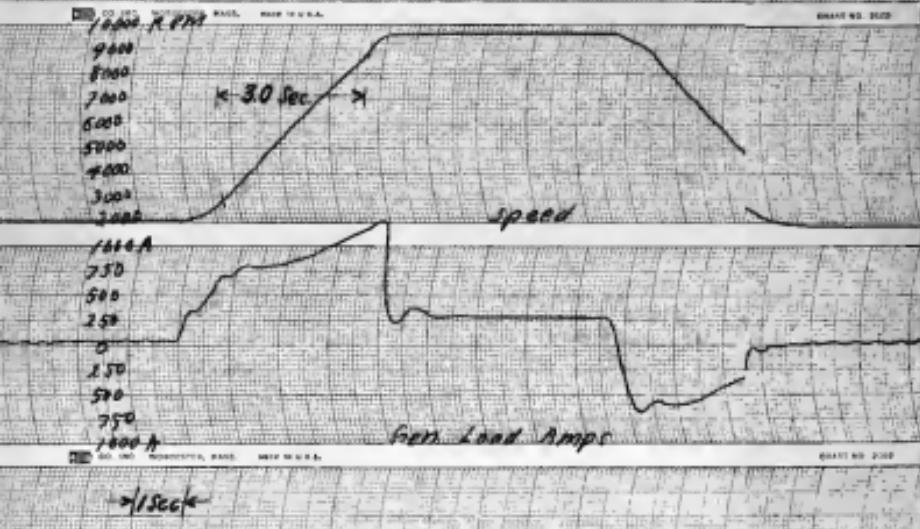
Refined analytical techniques are utilized by Task in achieving a maximum ratio of output power to weight in both AC and DC motors. Whether your problem is a high or low temperature, altitude, submersion in liquids, sealed unit construction, high starting torque, high rotational speeds, or geared drives... Task can build you a better motor, faster. Write for further details.



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1995 EDITION AND 1996 ADDITIVE EDITION

130 HP
130% FULL load
Accel and Decl



2000 RPM/second at 130% full load . . .

This is the performance that the Westinghouse test stand installation at North American Aviation, Columbus, gives time after time.

Other outstanding performance characteristics of this dual 100,000 hp test installation are

Speed adjustments from 100 to 11,000 rpm

Speed deviation 100% load change—not over 1%

200% load application—not over 2%

Recovery time: 200% load application—not over two seconds

Drift $\pm 0.5\%$ in eight hours

For overload testing, 150/300 hp is available for five minutes, 200/400 hp for five seconds.

Decelerating features include:

Two output gear boxes each provide 100 hp for their respective AND pads (dual or single mount)

Twin-drive systems operate independently, or they can be coupled for 200 hp delivery from the gear box at either end.

For testing alternators or for complete aircraft/missile electrical systems, Westinghouse test stands permit accurate simulation and evaluation of voltage regulation, transient response, overload capacity, paralleling operations and shock loading.



One of two control consoles of the North American Aviation, Columbus, alternator stand showing one motor drive motor and control transistors with monitoring instruments and motor control controls in background.

using Westinghouse alternator test stands

Take advantage of this Westinghouse ability to design, develop and install a guaranteed-performance unit for your production development programs for fuel pumps, alternators and complete electrical systems. Contact your Westinghouse sales engineer or write: Westinghouse Electric Corporation, P. O. Box 969, 3 Gateway Center, Pittsburgh 20, Pennsylvania.

YOU CAN BE SURE . . . IF IT'S

Westinghouse



Complete dual and 40-drive showing two of four AND pads with air craft alternator being prepared for testing. Multi motor generator units and dual turn-buckle control in background.

PROBLEM:

DESIGN AN ECONOMICALLY SOUND HEAVY-CARGO HELICOPTER

That's the challenge which has been assumed by Hiller's tip hubs helicopter concept.

The Hiller engineering and manufacturing team has spent almost a decade perfecting the tip driven helicopter concept. Design studies, economic analysis, and theoretical solutions, based on data from thousands of hours of tip jet helicopter flight tests, point to this unacceptable fact: that to satisfy all major design criteria the power plant must be able to deliver 100% excess engine load capacity that point.

The Hiller tip hub helicopter concept is the answer. The aircraft's weight is dramatically reduced and development and manufacturing costs are brought—for the first time—down to sensible levels.

Tip power provides the need for engine torque overspeed reduction and associated large fuel burns and losses. The increased engine power gives freedom in the design of fuselage and cargo space configurations. Turbojet engines provide the torque and fuel economy required to move the large tip driven rotors. And the engines are in effect weightless; they replace the blade tip weights needed to keep control surfaces down.

The need for heavy cargo and cargo helicopters is growing. Hiller technology is ready now with the practical solution.

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structure. Left-hand and right-hand rotors are attached to fuselage via by belts located in the top and bottom caps of the main spar and by angle belts at the front and rear spars.

Detachable tip of the main spar is fitted with a shank which is bolted to the main spar. Angle movement is 16 degrees up and down. Construction of the wing is of aluminum alloy formed parts, aluminum alloy skin and extrusions. Wing trailing edges are of honeycomb construction, main wing panels are classically styled. Lower cap of the main spar is constructed from two separate angled panels to provide the possibility of design cracks propagating across the complete spar section.

Wing vertical loadings are carried by the main spar and top and bottom skin stringer panels and are transferred to the fuselage by the main spar fittings. Vertical shear and torsion loads are carried by the torsion boxes formed by the main spar, skin panels and transverse webs. Drive shear movement is transferred to the fuselage through the front and rear seat unit fittings.

Single sheet flaps, minimum deflection 40 degrees, extend from the inboard end of the ailerons to the fuselage. Flaps are attached to the wing by three hangers and actuated at the control hinge. Mechanical interconnection ensures synchronous deflection.

The tail group consists of a one-piece horizontal stabilizer, a two-piece vertical, vented to the tail rotor. Stabilizer is of stressed-skin box design comprising a forward and aft shear web, a center sheet web in the internal section, classically styled skin and classically spined ribs. Spar caps consist of aluminum alloy strips toward the rear ends. Stabilizer is attached to the top of the fin by a short fin fairing at the center spar and a single bolt fitting at the center of the front spar.

Spin Tests

Initial Canadian design had horizontal stabilizer and elevators in normal position, but wind tunnel tests showed the airplane wouldn't spin. Moving the stabilizer forward up the vertical fin did produce a spin, but an angle ahead of the top of the crossbeam, known as the horizontal tail fin, had the desired directionality. In the final configuration, in which the chord of the vertical fin was increased, lateral tests reflected good directional stability and good control van characteristics. AVIATION Week was told.

CL-41 elevator surfaces are differential, with a single spin and full depth metal honeycomb sandwich material aft of the spin, reinforced by chordwise ribs

near the hinge points. Elevator actuators are interconnected by a torque tube and attached to the stabilizer via two hangers on each side. Elevator control movement is 25 deg. up, 13 deg. down. Balance tabs and trim tabs both have 10 degrees of travel in each axis. Nose wheel retract extends forward into the fuselage nose section.

The all-metal tail is of two-spar design with chordwise ribs, built in gear-struts to the rear fuselage. Main gear caps are of multiple construction. Leading edge is attached to the fin box at the front foot; a portion is detachable for access to elevator controls. Two hangers provide for rudder attachment.

Rudder Construction

Rudder is of aluminum alloy construction with a single spar, reinforced panels and chordwise ribs. Rudder movement is 30 deg. left and right. A ground-adjustable tab is provided on rudder trailing-edge lower section, with any much of ground clearance. Landing gear also is similar to that

of the Canadair T-33, with nose wheel derived from a design of Jerry Desautels, Montreal, for the Avro CF-105 (a combination nose wheel steering and landing gear), but unsteered. Main gear retracts inboard into the fuselage, with a nose and tail strut. Nose wheel retracts forward into the fuselage nose section.

Each main gear consists of an upper drag fairing and cylinder assembly and a lower piston and valve assembly which carry vertical and drag loads. Nose gear consists of an upper drag brace and cylinder assembly. Lower piston and fairing assembly carries vertical and side loads. Tongue holes prevent relative rotation of the shock strut bushings except through the steering mechanism. The nose wheel rotates, with rudder pedal pressure, up to 45 deg. from neutral, corresponding to a turning circle of 32-ft. diameter.

The airplane is equipped with dual control. Primary flight control systems



PRODUCTION view shows the CL-41 prototype in varying stages of construction. Note large-size inspection panels and rails across door in nose section.



TECHNICIANS install Pratt & Whitney JTCSR-2 turboprop engine. Plans can also see Armstrong Siddeley Viper, General Electric J35 and Rolls-Royce RR-126 engines.



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Mr. C. C. Littler

Box 626-M

Douglas Aircraft Company, Inc.
Santa Monica, Calif.

ing of 44,500 ft. Air pressure is controlled through a pressure regulator and limited in a short while in the forward pressure bellows.

Post-static safety is electrically activated. Windshield and forward 15 in. of the canopy can be defrosted and defrosted internally by an tap-off from the air conditioning system and controlled to a temperature of 25°F (3°C). A manually operated switch controls depth of antiicing warm air to the canopy air intake.

**USAF Studies T-38
Maintenance Time**

Los Angeles—In U.S. Air Force has disclosed that the Northrop T-38 Talon supersonic trainer will require less than 1.44 hr. of maintenance for each flying hour. Northrop Corp.'s North Division, manager of Training Command's scheduling, 14.3 maintenance hours per flying hour, and the figure is expected to decrease further once ATC maintenance rates become finalized for the aircraft.

In view of this study, Northrop expects its T-38P fighter, under way to the F-100, to have maintenance time close to the predicted 23.5 hr.

The maintenance study was based on three factors:



Lycoming Installs Coolant Clarifier

High capacity, enclosed coolant clarifier for use in gridding marine M-600 turbojet engines has been installed at Avco Corp.'s Lycoming Division, Philadelphia, N. Y. Clarifier is built by De Level Separator Co. and is called "Turbostar." Major advantage Lycoming says, is in elimination of scratches from abrasives in coolant.

- Experience with the Lockheed T-33 trainer.
- Standard with twinengined aircraft.
- Experience in introduction of new aircraft in existing squadrons.

ATC program scheduled 60 flying hours per month for each Talon. Comparison between T-38 and T-33 performance shows that the Talon requires approximately 14 hr. more maintenance than the single engined T-33.

Northrop personnel are conducting a flight test program at Edwards AFB, Calif., with the T-38 and has logged about 100 hr. since airplane first flight. The T-38 is undergoing a simultaneous flight test program at Edwards.

**P&W Orders Blade
Moment Balances**

Dynametrics Corp. of Burlington, Mass., has design, develop and manufacture for the Boeing Co. the balance barometers for Pratt & Whitney Division of United Aircraft Corp. under a \$55,000 contract. Barometers will be used to evaluate jet engine surface blades. As each jet engine turbine blade is inserted into a blade holding fixture, the instrument sets an intrinsic moment corresponding to the measured moment and stamps an appropriate code on the blade.



*Space wagons
with nuclear horses*



Space exploration will really come of age when manned rockets can leave earth, accomplish their missions and return without disposing of parts of themselves en route. This breakthrough depends on the rapid development of both nuclear rocket engines and space vehicles capable of using them. Douglas is putting forth a major research effort in the area of manned nuclear space ships. Every environmental, propulsion, guidance and structural problem is being thoroughly explored. Results are so promising that even if the nuclear engine breakthrough comes within the next five years, Douglas will be ready to produce the vehicles to utilize that tremendous new source of space power! Douglas is seeking qualified scientists and engineers for this and other vital programs. Some of our immediate needs are listed in the column on the facing page.

Einer Whistler, Engineering Vice President, Missiles and Space Systems, goes over new space objectives that will be made possible by nuclear propulsion with Arthur E. Raymond, Senior

Engineering Vice President of

DOUGLAS

MISSILES AND SPACE SYSTEMS ■ MILITARY AIRCRAFT ■ DC-8 JETLINES ■ CARGO TRANSPORTS ■ JETCOMS ■ GROUND SUPPORT EQUIPMENT

EQUIPMENT

Unit Converts Waste Rocket Heat to Power

By Michael Yaffee

Princeton, N. J.-Radio Corp. of America and Thielol Chemical Corp. have developed a new thermionic anode power unit which converts the waste heat from a rocket exhaust directly into electricity.

Target areas will be designated to fit around the flame tube or into the system.

second stage will have a design payload of 30 kilograms.

In addition to solid propellant rocket engines, the new motto, which are called thermionic energy converters, can be adapted for use as liquid propellant rocket engines, pumps, and on the afterburner section of jetburner carriers.

For continuous operations in satellites, these units will be designed to operate using solar, or more likely, nuclear energy in place of short-lived nuclear wastes. Furthermore, the new units are

capable of producing more than 1,000 m² of cleaned paper per square meter can function with an efficiency of 94%. With the present units, RINA scientists believe that they will be able to achieve a capability of 250 m² per hour with efficiencies approaching 95%.

In the foreground, a complete converter electrode assembly is visible and is not visible to the eye. Rings on either side of the electrodes attach it to a probe. Next to the probe is a probe assembly, attached to a base in order of insures and allows each converter probe to be easily

Bristol Division of Thadial would be the prime contractor and would be responsible for program management, application, design integration and remote laboratory. Electron Tube Division of RCA would be subcontractor to Hughes-Bristol and would perform thermionic energy converter systems, design and fabrication. Thadial's Thadial Division would also be subcontractor. Hughes-Bristol would be responsible for the test equipment, power supply and payload. RCA's David Sarnoff Research Center would also be subcontractor to the Electron Tube Division as a supplier and remote materials study and Battelle Memorial Institute, which would also be subcontractor to RCA's Electron Tube Division, would carry out gas permeability studies as possible outside materials.

Constitutive Characteristics

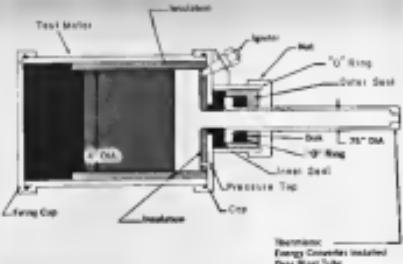
As indicated in the proposal, there are a number of problems that have to be solved before the first large thermonuclear energy converter becomes an operational reality. But the device does possess many characteristics which are attractive to utility: the weight, efficiency and cost especially, missile ergonomics. Chief among these are the following:

- **Simplicity.** The core-*co* has no moving parts. Basically, it consists of a cathode plate and an anode plate with a gas sealed between them and two wires to complete the electrical circuit.

Lightweight. The Silhouette model that produced 270 watts of electrical power weighed only 31 lb. RCA scientists believe this will eventually attain 150-175 watts/lb. Not only will the device replace comparatively heavy elements of batteries in other self-powered auditory units, but the capsule of the converter will become part of the mouth itself and so replace *in* equal areas of tooth material.

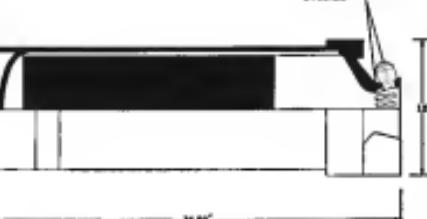
- **Waste heat operation.** The core cooler according to RCA and Thielol engineers, operates on waste heat and does not draw off much power from the reactor that would go into producing electricity. In this case, the *reactor* also *helps* to remove some of the heat from the module itself.
- **Large power potential.** RCA and Thielol consider a power capability of 40 watt/cm² and a conversion efficiency of 30% as being "practically achievable". The units built for power generation, they say, is the amount of usable surface area available as the

• **Low cost.** Thermionic power generation is expected to cost less than \$15/watt compared with an estimated \$1 200/watt for solar cells. (For a more realistic cost comparison, of course, it would be necessary to figure in the solar collectors or the nuclear reactor required to turn the thermionic converter into a



¹⁴ A sample of 1000000 consumers responded to the 2001 survey of small and medium busi-

INSERTS FOR MATERIALS AND PERMEABILITY STUDIES



THICKO and R&D steps in the proposed development program include plans to develop design and materials for components that can be built right into the expansion zones of solid propellant engines (above). Actual test setup (below), or Thiokol's Elgin laboratory shows thermal insulation in place on flame tube of end-burning solid propellant motor. Counterflow is covered with black insulation shield to reflect high temperature radiation. On coming of all shielded are ignition and electrical leads to load bar and to thermocouple pressure device.



EXPLODED VIEW of thermal converter shows, in the foreground, a complete converter with extra parts of fin and base. Behind it, the nozzle (length 70 mm and not visible) consists of four parts and of nozzle is shown the nozzle connector. Rings on either side of nozzle base have coefficient of expansion so nozzle will stretch it to nozzle. Next to last part is disk which is situated to face other fins (or heat fins) to cool cable connectors. Bottom translation in terms of converter is situated to basic unit of nozzle and leads to intermediate pipe. After conversion is done, nozzles inverted, leads are sealed.

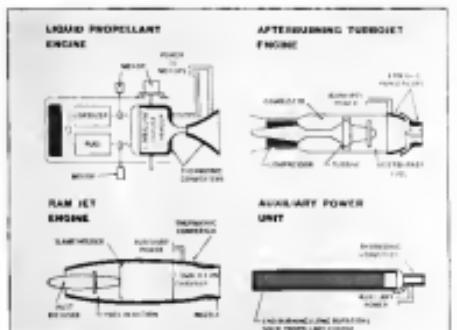


CHART illustrates some possible applications of new thermionic APU. Not shown are low current thermionic conversion recipient on heat from nuclear or solar sources.

Space Age Milestone!

Men's flight into outer space drew nearer on September 11, 1959 with the successful re-entry of NASA's "Big Joe" test capsule controlled by a Honeywell Stabilization System.

The guidance system for that capsule, launched by an Atlas missile, was provided by Honeywell—and it was delivered in less than half the time usually required for projects of this scope.

Rapid delivery was possible because the basic components necessary to accomplish this sensitive and exacting task were on the shelf or in production at Honeywell. However, two crucial jobs remained to be done. One was the task of designing a package for these components which would be rugged and exact enough to do the job, and the other was that of providing the ground support for system check-out and just-in-time launching. Both of these difficult objectives were completed in the time allowed.

The electronic stabilization and control system is designed to provide a reference that permits measurement of the capsule's attitude and rate of motion. By operating the on-off valves for the reaction control motors, it dispenses any necessary maneuvers of the capsule and eliminates the possibility of ramming.

The design and delivery of this system, the first of six such Honeywell systems for NASA Mercury capsule test flights, is in keeping with the accelerated man-in-space program and is typical of Honeywell's ability to meet such stringent requirements and critical deadlines.

This medium for the space age sums both from Honeywell's established policy of supporting the national defense and from the company's own business areas of interest. For further information concerning Honeywell's capability in space age projects, write Minneapolis-Honeywell, Aerometric Division, Dept. 611, 2650 Ridgeway Road, Minneapolis 13, Minn.

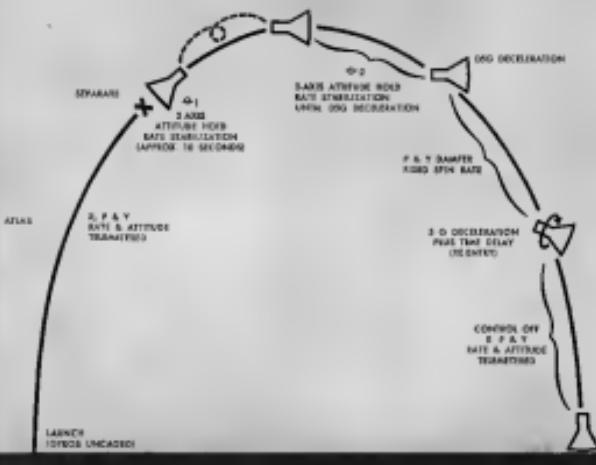


Final check of attitude stabilization control systems for flight and re-entry control of "Big Joe" test capsule is made by a Minneapolis-Honeywell technician prior to delivery.



The Honeywell "Big Joe" Control System assures control of separation and immediately provides a three-axis attitude hold, rate-stabilized and ready to maintain the reentry attitude (Ω_3). Approximately two seconds later, it programs the capsule to a pure attitude (Ω_3), and maintains this attitude until 0.5g deceleration is sensed, indicating that re-entry is commencing. Upon sensing 0.5g deceleration, attitude hold shuts off, pitch and yaw rate stabilizations are maintained, and the capsule is con-

tinued to spin at a 10° per-second rate until deceleration increases to 0.9g. At this point control ceases. With attitude reference control deleted, the blind end of the capsule slowly turns into the flight path due to its aerodynamic static stability. The rate gyro control dampens any tendency to tumble, yet permits the capsule orientation to move as required to keep the heat-resistant blanket leading. Pitch, roll and yaw attitude, as well as rate signals, are telemetered from onboard instruments



Honeywell

Military Products Group

**THEY
RELY
ON
RADIATION**

for "Counter" communications
antenna systems

Advanced Research Project Agency's
communications research "Counter" will soon
be placed into orbit.

The communications satellite will orbit
and receive up to twenty 100-watt
transmitters for messages, remote telemetering
and other scientific data. Called
"Counter," it is reported as a major step toward
long distance antenna systems for tele-
vision, radio, telephone, telegrams, mail,
and other needs.

Radiation was selected to develop, build
and test the ground-based antenna sys-
tem. Design and test work will be done
within the framework of the Army
Signal Corps' R&D Development Laboratory
(RDRL) and Police are the other prime elec-
tronic contractors for the project.

"Our communications engineers expect
the R&D laboratory to be a major center for
new research, and we are very pleased
that our 100-foot 'big dish' antenna will
spur on basic research.

**RADIATION IS A LEADER IN COMM-
UNICATIONS** Among current projects are
assignments in "Counter," "Hibiscus,"
"Thermal Air Infiltration Weather Study,"
and "Project Gemini."

If you'd like more information on Radiation
and why big dish antenna systems
Adams Radiators Inc., Best AWTT Member
Company.

Radiation's offices are at Melbourne and
Orlando, Florida; Mountain View and Palo
Alto, California.

RADIATION
INCORPORATED



COMPLETE thermoelectric energy converter,
developed by RCA and Thakol, fits over
flame tube of solid propellant rocket engine
and converts waste heat from exhaust di-
rectly into electricity.

continuous, long duration electrical genera-
tor comparable to the solar cells.
• **Flexibility.** Theoretically, the new
thermoelectric converter can be used with
any high temperature heat source, including
solid propellant rockets, liquid propel-
lant rockets, reactors, turbines, aircraft
engines, ground or aircraft nuclear re-
actors, and solar energy. The unit also
could be used in conjunction with General
Electric's new magnetohydro-
dynamic power generator to produce the
large magnetic field required by the
latter (AW Nov 16, p. 133).

Thermoelectric converters are not new,
but until recently they have been little
more than laboratory curiosities. Mili-
taries provide much of the impetus for
transforming these devices into useful
pieces of hardware. Until recently, the
efficiency of thermoelectric devices in con-
verting heat into electricity was too
low to be of much interest. But the
efficiency of these devices, coupled with
improvements in rocket engines, provided the high temperatures and en-
ormous amounts of heat that could make
these converters practical. Rocketeers also
provided the necessity which accelerated
their development. As rocket boosters
began to fail, it required more power
to move their vacuum controls.

Conventional auxiliary power units
that could move the nozzle of a large
solid propellant missile like the Minuteman,
for example, would probably be
fairly large and heavy. Too, the large
metal radiators in the new solid pro-
pellants make the use of a thermoelectric
device undesirable. Thakol wanted
a unit source of auxiliary power that
would have a better power-to-weight
ratio than present APU's, preferably
something that could offer an im-
proved source of auxiliary power.

In its search, Thakol came across
the work that Dr. Karl G. Henegar-

The best's have learning abili-
ties to teach my people
beyond the range of the
human ear. The high
placed order is com-
municated to me by
means of a signal and
guide the best
to the right path.

Faith Vassula
(Sonic Frost)



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If you have a problem involving antennas,
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Airesearch precision have been factory trained for this special program. Expert craftsmen utilize the newest materials and processes in building and installing lightweight, fully stressed interiors, lounge, galleys, lavatories and other appointments custom designed for the individual Gulfstream purchaser.

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Airesearch has more experience in pressurized aircraft than any other modification center.

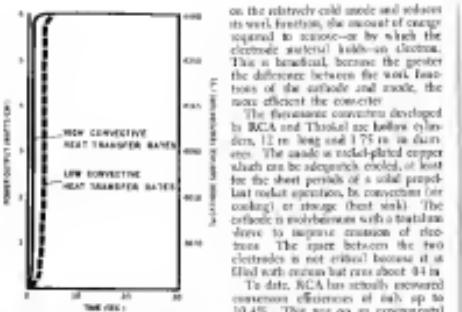
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Airesearch Aviation Service Division
International Airport, Los Angeles, Calif. • Telephone: El Segundo 4-4161



POWER output to mass is calculated due to thermionic conversion with tantalum cathodes placed in different positions in an expansion cone, one with the highest heat transfer rate being close to the anode. Chart at actually a cross plot of two curves, power output in watts, versus temperature and time to anode temperature, at which temperature below occurs cut-off.

and by colleagues at RCA had been doing on thermionic energy conversion. Dr. Hempeit had already managed to improve the efficiency of the device somewhat by using carbon vapor to reduce space charge effects in the same direction.

Booster, a thermionic energy converter is a very simple device consisting of a cathode and anode separated by a vacuum and connected by a cable that boosts through a load device where the electrons are taken off to perform useful work. With the cathode and the anode the electrons which travel through the current in the anode, out through the load device and back to the cathode.

Negative Charge

In a vacuum, however, the electrons, as they move from cathode to anode, build up a collective negative charge which repels the new electrons coming off the cathode and thereby limits the amount of current flow. To reduce this effect, RCA injects oxygen into the interelectrode vacuum. In a nuclear rocket, the natural gamma radiation could be used for the same purpose. When a gamma atom strikes the hot cathode, it loses an electron and becomes a positive ion, combining with the interelectrode electrons to form an effect, a neutral plasma which has high electrical conductivity and no space charge effect.

Some of the critics also complain

on the relatively cold anode and believe its very function, the amount of energy required to ionize—or by which the electrode material holds-on charge. This is beneficial because the greater the ionization, the greater the work function of the cathode and anode, the more efficient the converter.

The thermionic converter developed at RCA and Thielol are hollow cylinders, 12 in. long and 1.75 in. in diameter. The anode is nickel-doped copper which can be adequately cooled, at least for the short periods of a solar-pumped rocket operation, by convection (air cooling) or through a heat sink. The cathode is molybdenum with a tantalum sleeve to improve emission of electrons. The space between the two electrodes is not critical because it is filled with oxygen but can be as short as 0.4 in.

To date, RCA has actually measured conversion efficiencies of only up to 10.4%. This was on an experimental thermionic triode which had a tungsten cathode, and the 10.4% was obtained at a temperature of 2,910K. With their present tantalum-copper converter, Thielol and RCA are getting efficiencies of approximately 8% at 2,743K. In a rocket, conversion efficiency, which takes into account radiation heat loss from the cathode, is not as important as it would be in a ground-based power station because of the excess heat available from the rocket exhaust. More important for missile and space applications, says Dr. Hempeit, is the power-to-weight ratio.

Cathode Improvement

At the present time, RCA is working on ways to raise the efficiency through improvement in cathode and anode materials. Theoretical calculations show a potential conversion efficiency of 16.6% for a tungsten cathode operating at 2,743K. While the tungsten cathode is the best at the present time, it is not the best of a tungsten one can use. Dr. Hempeit, however, says that a tantalum cathode would be better. Theoretically, RCA and Thielol scientists say an anode material could be developed that would give a conversion efficiency up to 64% in that period.

However, at 1,480°F, tungsten evaporates at the rate of 0.66 mils hr. and tantalum, even faster. This presents a problem as far as the long duration operation that would be required of a converter in a satellite but not an intercontinental one, according to Dr. Hempeit. For one thing, he says, tungsten can perform as well or better than tantalum at lower temperatures.

This is only one of the problems that has to be solved. At high temperatures, tungsten and the other refractory metals are easily penetrated by molecules which could put the thermionic conversion out of action. This is



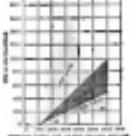
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M-D blowers operate at wider pressure and speed ranges than any other rotary positive blower. Capacities of 22 production models range from 50 to 4,000 CFM, pressures in 14 PSIG single, 70 PSIG multi-stage.

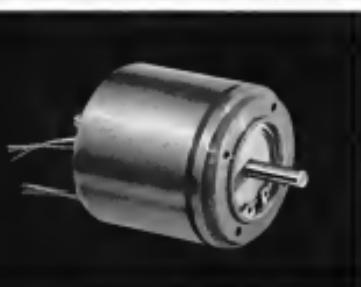


M-D BLOWERS, INC.
ROTARY POSITIVE



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ENGINEERING
REPORT
ON SENDIX COMPONENTS



ONE-MINUTE SYNCHRO SYSTEM ACCURACY

Electrical two-speed Autocollimator synchro features—

- ACCURACY UNAFFECTED BY THERMAL AND MECHANICAL STRESS
- HIGH SIGNAL-TO-NUL RATIO
- ELIMINATION OF GEAR ERROR FOUND IN MECHANICAL TWO-SPEED SYSTEM
- ADAPTABILITY TO GYRO PICKOFF

Developed to meet need for accurate data transmission with minimum system complexity. Produces two electrical outputs from single shaft, thereby eliminating connection of two-speed gear system as well as installation and maintenance costs of additional gear.

The synchro contains two separate sets of windings. One set pro-

duces the normal signal pattern of one cycle of output voltage, while the other produces eleven cycles for each rotation of the synchro shaft. Increase in accuracy is very close to the 14-to-1 theoretical maximum, resulting in a system error of ± 1 degree when used basic-to-back with similar units.

See a *synchro* now.

ADDITIONAL CHARACTERISTICS	
total weight (in. cube)	38 with 400 cycles, single phase
input current	300 mA max
input voltage	2.2 watts max
Rating to null spin	5000 rpm
Sensitivity (mV/degree)	3000

For more detailed information on specific applications, write—

Eclipse-Pioneer Division
Teterboro, N.J.



Shaw Blythe, Borden, and Associates, Calif., Seattle, Wash., Ottawa, Ont., and Montreal, P.Q., Canada
Tucker Associates, Inc., New York, N.Y.

the problem that Battelle would investigate under Phase I of the proposed program.

In Phase I, Thiozel and RCA propose to develop a number of different models of synchro converters that can be converted into and become part of the motor's rotor. These configurations will be made available in the hollow sleeve type, because the inside of the converter must be cooled, and says Thiozel, the expansion case is the heat part of a solid propellant motor for cooling. An air plenum, several air restrictors will be inserted around the expansion case and probably connected to arms to provide the 815 hp out put now desired by the Battelle Division of the Siegle Corp.

Remaining Problems

Among a number of other problems that still must be worked out are the following:

- Design. The thermoelectric converters will have to be designed to fit into existing structures.
- High temperature. Because the earth rod will be exposed to the rocket exhaust, cable insulation will have to be developed and fabricated which is in addition to good insulation, good high temperature resistance in its own right and surviving environment.
- Protection. Critical materials will have to be found that will withstand the severe rubs, as well as the surrounding insulation material (generally a reinforced plastic) that must be used in the rocket's environment.
- Electrical insulation. Thermoelectric converters are essentially low voltage, direct current. This is all right for simple, metal-to-metal control power. But the following and other electronic equipment to which they probably will be connected will require as well as higher voltage and lead-tapped resistors. While this can be done, it is almost certain to entail additional weight.
- Satellite adaptation. For long duration satellite operation, the heat source will have to be found for the converter. If solar energy is used, cell location and storage must be added and the absorption coefficient of the converter must be taken into consideration. With a nuclear heat source, the principal problem is in developing the reactor itself. Response of converter materials at the high temperatures is related because each must control (making the converter thicker, impose a weight penalty and eventually there would be a reduced heat source) excess of cooling the annule will have to be built into the converter or satellite.

While most of these problems can appear formidable, RCA and Thiozel scientists believe that all of them can be solved satisfactorily. These problems are critical to developing a reliable

one-stage converter that will work in spite of a long solid propellant rocket (that is, Phase I of their proposed development program), they estimate, can be worked out in one and-a-half to two years. The remaining problems and complete program development would require an additional 1.5 years with minimum effort.

PRODUCTION BRIEFING

Lockheed Aircraft Corp.'s Mississauga Division, Sunnyvale, Calif., will manufacture a 35 in. diameter spun fiber ring motor for the proposed two-stage space probe. The \$100,000 contract, too, is amounting to a high budget, 12 in. wide, produced by the Mississauga Division of the Siegle Corp.

Synchromechanics, Inc., Hawthorne, Calif., will produce sufficient two-speed converters for the Lockheed F117 under \$400,000 contract. The computer provides the speed input to the aircraft's navigation system.

Accept-General Corp., Anna, Calif., will conduct basic research studies of electrically exploded wire and sheet metal control from the Army's Office of Ordnance Research. The one-instrument-scope studies involve ultra high speed photography (1,200,000 cps) and stress combined with 25-power microscopes.

Standard Pressed Steel Co., Jenkinsburg, Pa., is developing ten-ton steel bolts at its works in the Lehigh Valley. The company claims that a 12-ton steel bolt has a bolt load, or strength, of 16,000 lbs, equivalent to twice the weight of high strength steel bolts. Development problems include reducing the weight economy of hardware.

Concord Tire and Rubber Co., Akron, Ohio, will supply 400-ply tire and steel strength torque for the Army under \$1 million contract. The 30,000 gal. rubber coated tire, which is 100 in. \times 10 in. \times 10 ft, will be used for fuel storage at domestic and foreign bases.

Gliese Metal Products Corp. has obtained follow-on contracts for the design, tooling and production of a nose gear steering and shutoff assembly system for the McDonnell 14111. Most recent contracts bring Gliese's total up to a projected total in excess of \$250,000.

Aerospace Corp., an affiliate of Aeroflex, Inc., has signed a contract with Fusion Arts, which will produce hard anodizing for electronic and missile components in the Fusion-Pressure-Fit business area.

AVIATION WEEK, November 23, 1969

Republic Aviation Corp. will supply spare parts for F-104 and RF-104 aircraft under a \$700,000 contract awarded by NASA's Maintenance Supply Services Agency, Penn.

Electronic Engineering Co. of California will supply three varieties of electronic data handling equipment to National Aeronautics and Space Administration's Wallops Island, Va., division under a \$207,000 contract. Without will convert rate accurate, derivative and range data from satellite tracking and range rate vehicles. The conversion will be made with an FIPS-16 meter, the others will be used with specially modified NASA radars.

Coast Electric Co. has received a contract estimated at \$600,000 from North American Aviation for development, testing, tooling and production of 2,200, 400 cycle ac coil relays for North American's B-57 bomber.

Siegle Corp.'s Holliston Electronics Division will manufacture electronic checklist instruments for the Army Sergeant model under a \$700,000 dollars-on-contract from Sperry Ordnance Engineering Laboratory, a division of Sperry Rand Corp.

Hoover Shaded Division, United Aircraft Corp., will produce four contracts for the Canadian Pratt & Whitney Aircraft PS-5 Interceptor fighter. The engine will use Hamilton Standard's PS-90 control which fits into a space 6 in. \times 14 in. \times 16 in. high. The contract carries 100 hrs of fuel on board.

Perfcoast, Inc., Pasadena, Calif., will deliver Model 3000 liquid oxygen transfer pumps to the Australian Department of Supply for use in the ground support system of the Blue Streak long range missile under the Woomera Test Range, Australia. Blue Streak is being developed by the British Royal Propulsion, Ltd.

Site for Nike Hercules installation at Vandenberg AFB, Calif., is under construction. Final determination of exact location will not be made until all surveys are completed and approved by the Army. Site will be located approximately 9 to 17 mi from base to be defended. Vandenberg officials will be comprised of two Nike Hercules batteries.

Douglas Aircraft Co. has entered a \$50.8 million Navy contract for follow-on production of the VAD TN-Sublight light weight jet aircraft. Performance ratings for the VAD TN-Sub will total approximately \$173 million.



CAM COMPENSATOR

Efficient compensating device for servo system errors.



The type CP-23-A1 is a simple, easily machined means of compensating for errors in output shafts in relation to an input shaft due to temperature or known environmental factors affecting the system. Errors may need to be adjusted periodically to maintain performance levels. Ask for full details.

CLUTCHED SYNCHRO

Transmits corrective signal, or accelerates new reference.



The type CP-8-A1 is an integrated unit combining a high-precision synchro with a clutch mechanism. It is designed for use in a servomechanism where it is desired to transmit a corrective signal to a servomechanism or to maintain a clutch of a torque-motor during excitation. Removal of electric-magnetic clutch excitation instantly re-establishes clutching. Acceleration is rapid. The synchro is used as a reference for proper output voltage as well as correct phase relationship of output voltage to the input voltage. Write for further information.

Manufacturing of
STICK - ROTATING COMPONENTS
KNEE DEVICE
PACKAGED COMPONENTS
INSTRUMENTATION

Eclipse-Pioneer Division



FAA Expands Radar Beacon Network

Mr. James A. Frazee

Atlantic City, N.J.—Federal Airways Agency plans almost completed coverage of the United States by ground satellite beams for its air traffic control satellite system within the next 28 months, and complete coverage in 1964, according to a report presented to the Radio Technical Commission for Aeronautics at its annual fall assembly by L. E. Shookman, head of the Boston System Section of FAA's Development Division.

Nine experimental ground facilities have been constructed to operational status through this month. These AIC beam ground installations, somewhat referred to as an secondary radar, improve an traffic control by extending the range and altitude coverage of primary AIC radar (AW 86, p. 126). It can thus be seen that conventional ground stations have been replaced by aircraft, the business ground installations transmit coded signals which trigger a receiver or transceiver in the aircraft which causes it to reply with a coded reply signal.

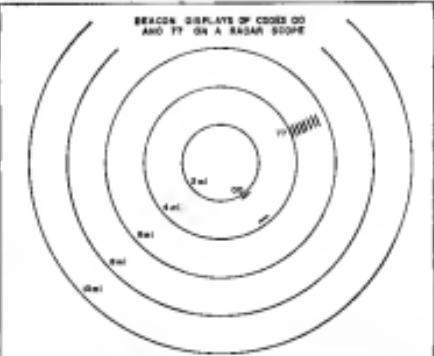
Thunder Mountain

As of this fall, the auditors have approximately 200 transponders in operational use and have placed orders for about 250 more. These will be used primarily to equip new aircraft. Also, provisions are being made for equipping about 300 additional new or retrofitted aircraft.

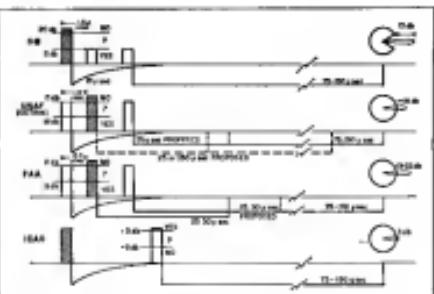
Because the MAT (Identification-Friend or Foe) equipment of military aircraft will respond to interrogation by civil ground stations of the ATC beacon program, military aircraft operating in the Common System for Air Traffic Control are essentially all considered to be beacon equipped.

They additional development programs being fostered by the FAA are • Lightweight, minimum cost transponder. This type of unit is required for the private pilot and other non-air carrier aircraft that are capable of IFR flight.

- Side-lobe and reflection suppression Study and selection of one system among the several systems of side-lobe and reflection suppression proposed in this country and the United Kingdom.
- Storage tube definitive Presently operating equipment for the suppression of unwanted beacon responses (de-



TWO CODES of the possible total of 64 codes available in the joint cell-military mode have been standardized under present plans on a nationwide basis. Code 77 of the cellular system indicates assault personnel, and code 68 on defense missions.



THE USE OF SUSPENSION SYSTEMS FOR AIR TRAINING AIRCRAFT. PART II. SYSTEM

Proposed multi-hole and reflection compensation techniques to date include Stewart-Wenner, USM's Rose-Setzer, and the ICAM standard two-pulse system. Systems proposed by EAS is a composite of the features of these other systems which is similar to the Cossor system developed by the United Kingdom testing organization.



TURBINE POWERED!

52 lb Solar "Titan" gas turbine passes exacting tests in 1-man helicopter

Solar Team Twente Borec heeft toestemming van de Raad van Bestuur.

NOLET'S LIGHTWEIGHT This gas turbine engine—smallest ever built for aircraft propulsive needs up to 125 lb on the Navy's T-REB-1 two-seat fighter-bomber. Both in both constant-speed and variable-speed configurations, the tiny turbine can produce rugged power for almost any application.

ation where small size, dependability and greater power are important. It is especially suitable as a power source for portable, handcarried electric generators. Power Intensity Solar gas turbines—ranging from 30 to 1200 hp—are creating new standards of performance and

ability in dozens of military and non-military applications. Write for information to Dept. G-173, Sather Aircraft Company, San Diego 12, California.

another subsystem from Giannini...

Stall Warning System for Douglas Cargomaster

A reliable, accurate system to provide advanced crew warning of approaching stall conditions was required for the Douglas C-133 Cargomaster.

Giannini met this requirement by designing a Stick Shaker Stall Warning System which produces a vibration on the control column...warning the pilot of impending stall conditions in time to permit corrective action. Giannini components making up the system include an angle of attack transducer, flap position transmitters, amplifier and control column shaker circuitry. For additional data on the Stall Warning System, send for Giannini Case Study No. 104.



Giannini Controls Corporation 918 E. Green Street, Pasadena, California

Engineering opportunities now exist at Giannini for work on similar avionic systems. Interested persons may write to the Director of Technical Personnel.

safe air traffic control for operation below 24,000 ft. Boundaries of these areas that will exclude aircraft not covered by radar surveillance. The FAA maintains the continuation of tower or route control functions for short-haul operations.

These functions will be equipped to operate compatible within the aeronautical system.

Control areas will be responsible for traffic control and aural and visual information. The tower also will be responsible for the area within the immediate vicinity of the airport under the visual surveillance of the controller. Other responsibilities may be delegated to the tower or a transition-terminal or en route facility.

Side Lobe Suppression

One of the future developments anticipated by the FAA is the implementation of a system of side lobe suppression for aural and aural suppression. Their now exists an International Civil Aviation Organization standard two-pulse side-lobe suppression system for use of the radars not likely to be used within the United States in the immediate future. At the time that this standard was set up, no agreement could be reached between this country and the United Kingdom on a suppression technique for the common surveillance mode to be used here.

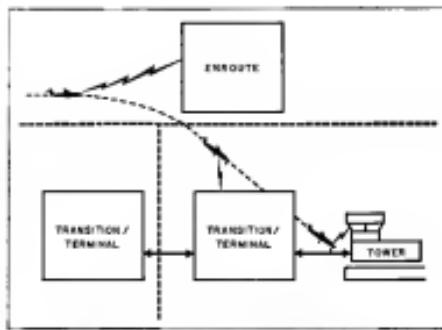
This summer the FAA sent a delegation to the United Kingdom to discuss the characteristics of the proposed two-pulse suppression technique.

This proposal was based on extensive field operation tests in the high density New York area, plus data gathered from simulation by means of a mathematical model.

The proposed FAAS system is a composite of the better features of several previous proposed and tested systems, including the Stevens-Warren, Remm-Soren, and the ICAD standard two-pulse system. This composite system is similar to the Cimex system advocated by the U.K. at the time the ICAD standard was set up. After a two-year study by the British of the FAAS test results in the New York area plus those of their own, the committee of responsible manufacturers, airline operators, and the military aviation committee during the FAAS approach have been informed.

When national and international agreement is reached, the FAA will adopt the resulting system characteristics and direct its use by both civil and military users of the common ATC system.

The final development in progress is the change-over type debarrier. By retaining the end-of-response pattern of an auralic transponder system



AEROSPACE over U.S. will be under the control jurisdiction of three basic air traffic control facilities, an aural, transition terminal, and aural traffic control tower.

during one interrogation cycle and comparing it with the aeronautical pattern received during a second interrogation cycle, it is possible to display only the replies that are synchronous and reject, or剔除, the aural transmission return and voice commands referred to as front.

The question is that is called immediate and delayed, and the flight reporting function that the basic transponder is then has been converted into a data link.

According to Shulman, this represents one of the possibilities being considered. He said that, in the long distance, heading, air speed, or other aircraft data stored on the ground could be relayed to the liaison. The question is as to whether such information will be supplied by the beacon system or by another means such as ACARS (Automatic Air-Ground Communication System) is largely an operational decision.

Additional Improvements

Other planned improvements contemplated for the beacon system are:

- Increasing the number of possible reply codes from 64 to as many as 4,096. This possibility is being considered and can be made available if provided by operational needs. Twenty experimental transponders are being developed now with the capability included.

- Performance radiotac for the ground interrogation facilities, and improved beacon antennas are planned. Beacon altimeters for the PAR (Precision Approach Radar) and ASR (Airport Surface Detection Radar) system will be provided if needed.

- Multiple channel decoder, capable of decoding altitude data as well as identi-

Republic F-105 – One Plane “Bomber Formation” Depends Upon Holley for Fuel Control



New Wings for the Eagle!

World War II's Dated Eagle Squadrons, now the 313th Squadron of TAC's French Fighter Wing will soon be flying the F-105 Thunderchief.

World's most powerful one man airplane, is reported to carry "as much destructive power as an entire big bomber formation of World War II." Capable of carrying an atomic bomb, the exciting Republic "Thunderchief" gets more than 25,000 pounds of thrust from its Pratt & Whitney Aircraft J75 jet engine with afterburner.

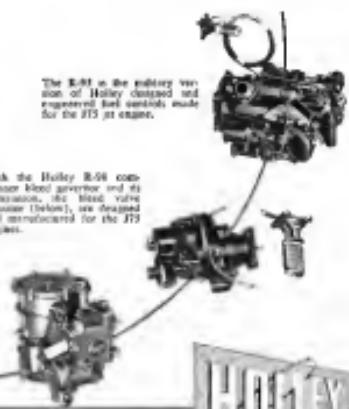
Holley designed, engineered and manufactures the main fuel control, bleed governor and actuator for the J75 engine which has both military and commercial applications. The Holley R-95 control combines "small package" design with light weight and exceptional performance reliability. It's another important reason why more and more engine and air frame manufacturers are turning to Holley for engine components.

This impressive array of fire power shows why the Republic F-105 operates at its often called as the "one man aircraft."



The R-95 is the military version of Holley's proven and ruggedized fuel controls made for the J75 jet engine.

Look the Holley R-95 carburetor, bleed governor and its combination, the bleed valve actuator (valve), are designed and manufactured for the J75 engine.



HOLLEY
Carburetor Co.

A-39 11955 E Nine Mile Road
Warren, Michigan

Leader in the Design, Development and Manufacture of
Holley Fuel Metering Systems



Marcani Radar Installed in New Zealand

Wellington, N.Z., against low severely modified Marconi Warbler Telegraph Co's Type S25A 500 kcs, 10 cm radar. Dual transmitters receive information in a code based on a single L3000 H₁ logic, and is mostly controlled from the Airways Control Centre via a four-line telephone microwave link. Radar target data also is transmitted to the computers over a second microwave circuit. Radar and microwave systems are shown above.

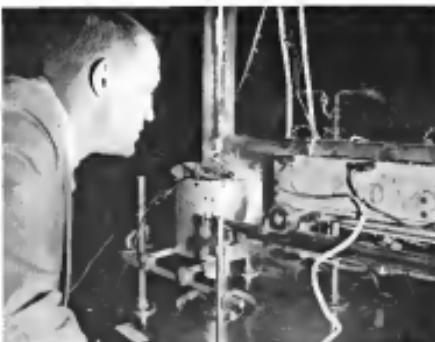
fiction, is scheduled for development soon. This device will be incorporated into the atmospheric processing and ground display equipment being

Some of these changes may necessitate modifications of equipment now in use both on the ground and in the air. Shown in the third, however, that these modifications would be made only if they provide a sufficient improvement in the AIC sense to justify them.

IGY Satellite Tracked By Chance Vought

Bell, Tex.—Tracking and monitoring of satellites passing the Hawaiian Islands and a test being provided by Choice Vehicle Assess. Inc.'s Bang System Division. Under an expanded Navy contract, the division is tracking and recording teleinked data from National Aeronautics and Space Administration's Jason 3GY communications relay satellite.

Space vehicle monitoring must be expanded to include other satellites in the future. The NASA satellite is collecting data on radiation, charged particles and meteorites. For the past six months, the company has been operating the Pacific Marsh Banga's fleet mining faults, tracking and collecting antenna data for test vehicles and current launching. Regulus I started. The solar air track aircraft flying simulated Regulus attack patterns. Nitro-



Battelle Produces High-Purity Compound



NEW AMPLIFIER PACKS 90 DB IN HALF CUBIC INCH VOLUME

Now 455 kg three-stage amplifiers developed by the U.S. Army Signal Corps utilizing the facilities and competence of General Electric produce up to 90 db gain with 3 kc bandwidth in one-half cubic inch volume. This degree of miniaturization evolved from sustained research and development in solid state filters, delay lines and transformers at the Electronics Laboratory, Electronics Park.

The unique bar-shaped transformers developed for these amplifiers, combined with improvements in existing ferro-electric ceramics, permits the most compact packaging with extreme gain. This achievement in research and development is indicative of General Electric's technical competence in defense electronics.

Process & Go After Impactful Projects



DEFENSE ELECTRONICS DIVISION
HEAVY MILITARY ELECTRONICS DEPARTMENT
SYRACUSE, NEW YORK



Reliability Emphasized in AN/ARC-58

AN/ARC-58 high frequency single sideband airborne transceiver has completed a round of 160 hr. static tests between failure, according to Collins Radio Co., which developed the equipment for the Air Force. Transistor reliability can share the blame, all production units through a maximum of 40 hr. of operational cycling to simulate combat use. Collins claims over 500 design improvements early in the program to its reliability program.

posed to the use at temperatures of 90°F for thousands of hours. Reliability is projected with 24% downtime, and 76% silicon can provide count rates of 100 to 10,000 ohms per square, depending upon film thickness and composition of substrate. Insulation oxide film is a count rate of 0.01 to 0.001 ohm-centimeter, permitting its use as transparent electrodes.

• Signed on the Dugout Lake-Majestic contract, recently announced by various manufacturers include the following:

• Federal Dynamics, International Telephone & Telegraph Corp., Chelten Hills, \$14 million award from the Marine Co. for production of guidance units for Lancer missile.

• Willys Electric Co., Kenosha City, \$5 million contract for T-34C-10 doppler radar system from Trans-Canada Air Lines for installation on its Douglas DC-8 jets.

• Avnet Electronics Corp. reports net sales for the first quarter ended Sept. 30 totaled \$2,152,000, compared with \$1,345,246 for the same 1968 period. Net profits after taxes for that year's first quarter were \$255,715, compared with \$16,482 for the quarter ended Sept. 30, 1968. Avnet Electronics pro-

duces and distributes communication and other items.

• Packard Bell Electronics, Los Angeles, \$576,000 for airborne interrogators for use in intercept and refueling aircraft, from Air Materiel Command. Design emphasizes radio transponder in an other aircraft and digital readout of air navigation units.

• Radar data handling equipment for National Aeronautics and Space Administration's rocket test station at Wallops Island, Va., will be built by Electronic Engineering Co. of Calif., under a \$307,000 contract for three systems to convert data from remote tracking radars for computer input.



Miniaturized Cathode Ray Tube Developed

Miniature cathode ray tube assembly, resulting from a combination of powder metallurgy and modern vacuum tube technology, has been developed by Sylvania Electronic Products, Inc. External radiating surface of the barium-titanate assembly is much more slender than conventional structures. Assembly is shielded by H. E. Stanghellini of Sylvania

laboratory of the other aircraft from its response.

• Consolidated Avionics Corp., Westbury, N. Y., \$480,000 award from Air Materiel Area for data processing

• Rockwell Co., Little Falls, N. Y., two letter contracts totaling \$1.2 million from Air Materiel Command as initial funding for product improvement programs on its AJA-1 radar tracking computer and NI directional gyro computer system, jointly designated the AN/APN-6, and on Boeing B-52 and KC-135 aircraft.

• Radiation, Inc., Melbourne, Fla., \$476,000 to aid in developing high format converter for converting airborne television data from Marconi's intercontinental satellite results into a form suitable for direct data and ground-based reception. Contract is the third awarded to the company for the Marconi program.

• Consolidated Electronics Corp., Pasadena, Calif., \$132,000 award from Federal Aviation Agency for recording cockpit dialogue to be used for flight inspection of air navigation aids.

Airborne Digital Timer Highly Accurate

By Erwin J. Baffon

Dallas, Tex.—Precision, lightweight airborne digital timing system developed by Tencor Aircraft Corp. for USAF is noted as having an accuracy of one part in 10⁷, with starting accuracy within two microseconds of setting. System provides visual indication in the form of five-digit numerical digits as well as video signals for audio and/or graphic recording. This signal is in the form of a binary decimal code furnishing real time reference.

Developed by the Tencor Overhead and Aeronautics, Goleta, Calif., the system can be started manually by entering set chosen time or automatically synchronizing the time generating process with transmitted signals. It automatically corrects for propagation delay time.

Further development includes a weight reduction program (present weight 78 lbs with one remote clock and one reader control), use of robotic programs and extension of synchronization to include all known standard time signals throughout the world.

System operates at U.S. time signal WWV.

System works as its own decoder and reader device for previously recorded binary coded video signals, providing real time display in decimal form to the control panel using the remote reader control.

Time referencing can be refined below the one-second level with 0.1, 1, 10 and 100 microsecond markers.

Basic Components

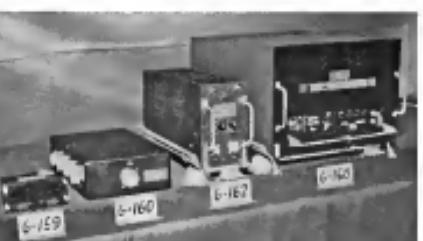
Basic components making up the timer include: time encoder, remote clock, precision box, remote reader control and power supply. The time encoder reader is of a digital electronic circuit utilizing integrated circuit packages and transformer-ground circuitry. Miniature ceramic clocks are used in precision oscillator tubes for prevention of real digits.

Transformer power supply uses both magnetic and transistor regulation. Silicon semiconductor devices and tantalum electrolytic capacitors allow operation in ambient of -50°C to 70°C without forced air cooling.

System is designed for operational simplicity and minimum of operator skill. Dial controls are used to put in current sales data accurate to within an automatic WWV timebase, the system converts reference to propagation delay time so that the signal is set to generate real time as soon as it receives the transmitted signal.



MODULAR DESIGN in Tencor Aircraft Corp.'s time encoder reader provides fully transistored printed circuitry, with parts easily pulled out for inspection and servicing. USAF application to provide real time for data acquisition is meant and may assist so far as



AIRBORNE digital timing system developed by Tencor Aircraft Corp. consists, left to right, remote clock, precision box, power supply, and time reader reader. Entire system weighs approximately 78 lbs. Further development includes a weight reduction program

CLASSIFIED



General generating

General Electric has been selected to supply the advanced-design secondary electrical power generating system for the North American B-70 Valkyrie, the Air Force's new MACH 3 multi-purpose bomber.⁷ Designed for supersonic high-altitude operation with inherent long-range flight endurance and large load-carrying capability, the B-70 can be adapted to offense, defense, reconnaissance, or special mission requirements.

The new, specially designed G-E system consists of an Infante-Laudel generator, controlled-rectifier regulator, and protective panel. The revolutionary generator, when applied to aircraft systems, will provide extreme system availability by eliminating wear-mechanical brushes, slip rings, commutators, rotating windings, and rotating rectifiers.

Development of this system for MACH 2 aircraft offers a challenge never before encountered in manned aircraft. New lubricating and insulating methods and new sturdy, compact construction are needed to stand flight stresses three times the speed of sound at altitudes previously approached by operational aircraft.

Some equipment will be required to withstand temperatures at 600°F, vibration input of 15 g's (as much as 60 g's locally), and shock of 20 g's. Extreme reliability is, of course, a must.

In developing this equipment, General Electric is using experience and knowledge derived from the material and component development phase of a separate Air Force High-temperature (HOTELEC) Program under sole contract from North American Aviation. G.E.'s completely equipped research and manufacturing facilities are ideally suited to develop and produce advanced systems the HOTELEC and the B-30. And, G.E. leadership in secondary power equipment extends through 40 years and more than 50 different aircraft.

Hanns Tietz AG is manager of the 2000-tonne-a-year synthesis for North American customers.

Aircraft pictured represent only a few of those for which G.E. has developed secondary power-generating systems.

Electric's new concept in aircraft systems is awarded B-70 contract

Design Concept

Design innovations in the new GE generating systems will provide outstanding results in these areas.

- **Reliability**—Key to the increased reliability of the G-E system, is the revolutionary Inducto-Faucell generator. Field windings and rectifiers will be located in the rotor instead of the stator as in conventional turbines. Lower component temperatures result from shortening heat transfer paths between windings and cooling.

In addition, all available control components—relays, transistors, magnetic amplifiers, controlled rectifiers, capacitors, and resistors were fully

explosives, and recovery—were duly evaluated as to performance and reliability. Then exhaustive research—spurred by computers—was conducted on individual circuits of each system to determine the combination of components which would provide maximum reliability and minimum weight for each particular application.

- Electrical configuration—it is planned that the B-70 system will consist of four 60-kva generators in parallel for main and emergency power.

through their systems, indicating there will be a prime integration of generators with necessary control, regulating, and protective components.

Wright also will be used in another way. In analyzing the complete B-33 system, North American electrical engineers felt that the long feeder runs from generator to load offered an excellent opportunity to evaluate a variety of generator voltages, feeder sizes, and transformer designs to determine

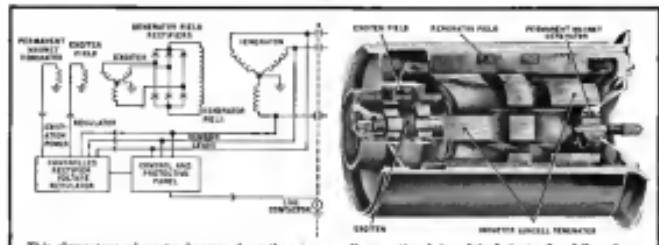
service the optimum compromise Coordinating with General Electric indicated the practicability of such a design breakthrough. As a result, it was decided that power will be generated and transmitted at 280/260 volts and stepped down to 115/280 volts at the step by novel transformers designed specifically for this application. A net weight saving in the aircraft of hundreds of pounds was thus accomplished together with improvements in electrical transmission and control efficiencies.

Future Application

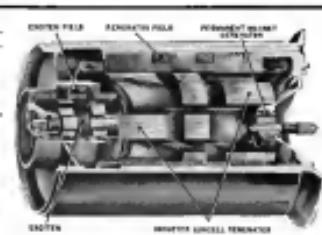
General Electric research on this system holds bright promise for future applications. Further development will make similar systems available in many future ratings and sizes for other types of aircraft. For more details, contact your General Electric Avionics and Defense Equipment Sales Office or write Section 750-1, General Electric Company, Schenectady 5, N. Y.

Progress Is Our Most Important Product

GENERAL  ELECTRIC



This elementary educational diagram shows the arrangement of gaseous and liquid components.



Cross-sectional view of the Induction-Landfill configuration of the secondary power systems generation.



NRIF delivery of an Aerocar pre-production model it made to Mansfield Airways, Massachusetts dealer for the vehicle.

Airline Week Pilot Report

Aerocar Makes Quick Airplane Transition

By Barry Tully

Teterboro, N. J.—Aerocar, the flying automobile, is ready to take in the air (at the road) after an 11-year gestation period.

The two-seat vehicle, designed for the man who wants to drive in the airport, fly to another and drive to his ultimate destination all in the same car, will be produced in 1968 if present licensing negotiations are successful. Aerocar, Inc., Longview, Wash., developer of the vehicle, is negotiating with United States and European manufacturing companies for the production of the Aerocar. At present, it appears likely that the Aerocar

will be produced in West Germany.

One pre-production unit has been sold to Mansfield Airways, a Mansfield, Mass., dealer for the vehicle. Aerocar, Inc., says it now has 52 firm orders (\$4,800 deposit) for the Aerocar at a unit price of \$9,300. The delivery schedule is 100 orders prior to production.

Aerocar N915D was demonstrated to Aviation Week, in all its model of utility, at Teterboro Airport by Mansfield Tully, the vehicle's designer.

Unusual Characteristics

In its flight configuration, the Aerocar presents few unusual characteristics to the observer.

• Four-wheel landing gear provides road

ability when the vehicle is in use as an automobile.

• Internally-mounted engine, a four cylinder Lycoming 0-310 developing 145 hp, is located behind the cabin seat. A fan cools the air-cooled engine. • "T-tail" configuration has horizontal stabilizers with 25 deg positive dihedral and the vertical fin and rudder projecting downward from the fuselage.

• Pusher propeller, a ground-adjustable Hartzell, is mounted on the empennage aft of the control surfaces. This propeller, however, although not organizing with the Aerocar, undoubtedly is the same model among aircraft of its class. It flies, however, the air-mounted prop appears to produce no adverse effect and obviously generates a smooth airflow about the wings and fuselage.

Aside from the Aerocar's unique configuration, the most impressive feature about the vehicle is that it does what its proponents say it will do. It flies, down, covers four seat configuration to another (approximately 5 min and tow in flight) components are self contained.

The Aerocar, as is evident, is a two-place, high wing monoplane with an internally-mounted engine driving a pusher propeller on the empennage by means of an 11 ft shaft. Wing span of the aircraft is 34 ft, and length is 21 ft, 6 in. Empty weight is 1,700 lb, and useful load is 600 lb; allowable luggage weight is 100 lb. Dual aircraft controls are provided in

the Aerocar. Steering and elevation movement is controlled by means of the large automotive steering wheel on the left and with a small control stick for the right seat occupant. The steering wheel, which moves forward and aft to provide pitch control, is linked for automotive use and unlinked by breaking the rudder pedals. Two sets of master pedals are provided and the hand throttle is located in the center of the instrument panel.

The automobile clutch, brake and accelerator are located between the master pedals on the left side. This requires a certain amount of orientation, particularly for the pilot who must remember to use the automobile brake when taxiing. The pilot also has the option of using the foot throttle when taxiing.

Aircraft instruments in N915D are limited to a tachometer, altimeter, air speed indicator and cylinder head temperature gauge arranged versus the panel.

A bold indicator on the left provides a balanced flight check, and a magnetic compass is located above the windshield. The fuel quantity gauge and the oil pressure gauge are arranged with the tachometer.

After starting the engine, the automotive gearbox can be engaged in reverse gear and the aircraft will move backward with the propeller turning in reverse, the gear lever in place and in neutral.

Easy to Tax

Taxing the Aerocar is quite easy. Directional control is maintained with the steering wheel, power is applied with either the automobile accelerator or the hand throttle and the foot brake slows or stops the aircraft. Most people use the foot throttle to tax, in the engine reverse to idle, open the reverse gear lever.

Tully says the Aerocar will become airborne in 600 ft. At takeoff roll, however, look considerably more than that distance. After taxiing out for a rolling takeoff, I continued to accelerate the vehicle using the hand throttle. Tully remarked that this technique would produce only 3,500 rpm (190 hp), hardly enough for takeoff. An aborted push on the hand throttle brought the desired 2,500 rpm (170 hp and 135 hp) and the takeoff was confirmed.

Directional control throughout the takeoff roll was excellent. The Aerocar is steered by means of the steering wheel and the lateral response is felt in the seat. A slight correction will bring the front wheel to the centerline. Increased rotation at about 55 rpm will bring the aircraft off the runway nicely. However, conservatism and a long runway help to bring the plane on the



Cessna 150 Fitted with 'Patroller' Door

Two-place Cessna 150 utility lightplane now is available with "patroller" door fitted with a Plexiglas panel in the lower half to provide increased visibility during pipeline patrol and search operations. These doors can be purchased separately and fitted to any of three versions of the Model 150 at a cost of \$100, on an exchange basis. Patroller wings, with a usable fuel capacity of 35 gal, compared with the normal model 21.5 gal. fuel capacity, increase the normal range from 600 mi. to 900 mi. and are available from the factory, option on an exchange basis for a cost of \$137.50. A message chute, costing \$10.50, also can be added on the left side of the Model 150 cabin, just in front of the pilot's seat. Photo at top shows the "patroller" door installed on the cockpit's side. Below, increased downward visibility from the pilot's side is evident in the photograph taken in flight.



AEROPLANE, automobile, four-place Aerocar version, will utilize Aerocar wing and tail and will fold in wing (the stamp). The nose is lengthened and the automotive components eliminated to provide for two additional passengers.



Esso was ready with fuels for the jet age

Time has pioneered in aviation ever since there was aviation!

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- Esso developed the first 100-octane aviation gasoline.
- Esso had jet fuels and lubricants ready before the commercial planes that won them were built.

Today, Basso and affiliated companies are proud to be a major supplier of jet fuels and jet engine oils to leading airlines throughout the world. High quality aviation products are also available to general pilots through dependable Basso Aviation Dealers.

Highways or Skyways... ESSO RESEARCH works wonders with oil

The logo for Esso Aviation Products, featuring the word "Esso" in its iconic red script inside an oval, with "AVIATION PRODUCTS" in smaller red capital letters below it.

deck until reaching 70 mph on the first takeoff.

The ascent climbed on at full power indicating 50 mph. Rate of climb was estimated to be about 300 fpm. The Aeronca was quite stable in climb and engine power was excellent.

The ground reference landing characteristics of the Aeronca are quite good. The aircraft is remarkably stable in climb, glides, turns and an level flight. The light rudder effectiveness at low altitude near the ground did not affect the overall aircraft stability.

Flying with the large stabilator type aileron wheel, however, does require a precise adjustment. Adjustments must be made to the aileron and the rudder of the aircraft for level or turn-and-climb, roll-over and roll-out. It is difficult to demonstrate a wings-level attitude. This, no doubt, causes the pilot some concern.

One unusual flight characteristic of the Arrow is the large control surface movement necessary to bank the aircraft. This is caused by the memory to combine the steering geometry of the front wheels with that of aileron deflection. The compressor aerofoil rather "tight" aerofoil steering and extremely loose aileron feel.

Editor's Response

Rudder response of the Aeronca is offset, particularly at low airspeeds. In the aircraft at a nose-high attitude when turned for hands-off level flight, the aircraft will make a good banked turn after the initial yaw into a skidded roll.

1. Stalls, both power-on and power-off, were conducted with the aircraft in both cases the aircraft stalled at approximately 45 mph, indicated as a flickering number indicator. The stalls, in both cases, were completely stable without violent pitch down or tendency to drag a wing. Control response was good right down to the stalled condition.

Recovery, made by dropping the nose to a level flight attitude and adding power, resulted in very little loss of altitude. The lack of aerodynamic stall warning (buffet) necessitated the utilization of a stall warning indicator which sounds the automobile horn. All stalls were conducted in the "flat" configuration. The Aeronut is not fitted with flaps.

The Autocar cruised at 100 mph in level flight at a power setting of 2,450 rpm. Time spent in level flight is 110 mph and V_{∞} is 130; plane is restrained from accelerating maximally. The 20.5 gal fuel tank of the Autocar gives it an approximate still air range of 300 stat mi with no reserve at its fuel

A black and white photograph of a vintage propeller-driven airplane, possibly a Cessna 172, flying low over a range of rugged mountains. The plane is angled downwards, with its landing gear extended. The tail features a prominent Swiss flag. The background consists of dark, craggy mountain peaks under a cloudy sky.

Second Prototype Porter Demonstrated

Second prototype of SpaceBelt Photo-Faster with parabolic transport plane is demonstrated over the Sennar-Gebredash (above). Aircraft now is available with either a Boeing 777-300, engine or a supercharged Lycoming 140 hp piston aircraft. Photo can be converted to a 1000 lb. load configuration for photo aircraft usage. Below, a group of paragliders make up a 1,300 lb. load for a typical rescue mission.



weather is bad, drive at $\frac{1}{2}$ Not only does the weight penalty of the softshoe requirement (360 lb.) preclude the use of gas instruments, but the 100 mph cruise (100 hr. gas) and the 3 hr endurance make it impractical to operate under instrument flight rules.

the aircraft is equipped with navigation equipment, the enhanced life belt, and a survival kit. Survival tests have been conducted on the enhanced life belt, but no survival tests have been conducted on the enhanced flight. However, it became apparent to leading that passenger equipment are accurate. Taylor recommended an approach power setting of 1,100 rpm which brought the aircraft into a steady climb.



52965

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The AW Amtrak can carry up to 12 passengers or 181 short tons of freight, or any combination of these that pay off. A typical mixed load would be over 7 tons of freight and 36 passengers. The 60-Hpere Delti four-pole power engine's low noise level for the passengers seated in pressurized comfort. Large fore-and-aft freight loading doors reduce turnaround to 20 minutes. Components and systems are all well-tried and chosen for easy maintenance. Both passengers and freight can be loaded simultaneously.

PERFORMANCE Power: 4 Rolls-Royce Dart.
 Aircraft cruising speed: 24,000 ft p in 2,898 mph.
 737 km (451 mi). Maximum payload: 27,000 lb (12,270 kg).
 Range with fuel reserves and 20,000 lb (9,072 kg)
 payload: 1,000 mi (1,609 km).
 Size of hold: 46 ft \times 8 ft (14.22 m \times 2.44 m).
 Gross area: 420 sq ft (39.46 m²).

THE ARGOSY RAISES THE COST OF AIR FREIGHT DOWN TO EARTH

HAWKER SIDDELEY AVIATION 36 Queen Street, St. James's, London, S.W.1



with shock absorbers), held up until Taylor demonstrated a hand-off landing, and while the aircraft landed for the sake of the runway under the influence of a slight crosswind, it was quickly straightened out when the front wheels touched down. The expandable take broken was effective and slew the aircraft in a straight line. The company says that the Aeromac can be held up to a stop on landing in 300 ft. This was not tested, however, nor were crosswind landings.

Operating the Aeronca presents certain known button problems that are in a way to confuse the control methods of flying and driving. This confusion, while not unknown in commercial aircraft, is unique to occur in the Aeronca. The control environment is the same for both flying and driving. Careless combinations of this include using the hole while flying, grabbing the hand throttle to start while driving, or in my case, attempting a takeoff with the automobile accelerator. Most of these shortcomings disappear. However, pilots should be cautioned against them, particularly when performing habitual actions.

To convert the Aviator to an anti-submarine, the wings are first unloaded by manually releasing two locking pins at either side of the cabin. Small bracket supports are then removed out of the wing根部 and, after detaching the wing struts, the wings are folded back so the center of the Grammatici, 500 and 500s. With the wings folded in this manner, the shift in weight distribution causes the front wheel to be lifted from the ground. This is prevented by creating a support rod out of the left wingtip which also serves to support the trailer when it is not being towed. The solvent fold back on the upper wing surface is 90° in diameter to the horizontal stabilizer.

These locking pins are subjected to separate the wing and tail section from the fuselage. The prop shaft breaks at a clevis, and the control cables separate at rocker assemblies requiring no disconnection or release.

The eight component trailer is 15 ft. long, 8 ft. high and 8 ft. wide, weight is 400 lbs. The assembly is of aluminum construction as opposed to the glass fiber rate boats. If the trailer is to be towed, it is to be harnessed and connected to a trailer hitch which is fitted to the back of the car. The only tool required to remove or attach the eight components is a small screw driver that is carried in the car. Locking jacks prevent the starting circuit from being energized unless all five are set down.

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U.S. Business & Utility Aircraft Shipments

automobile in the State of Washington. The company now that it will meet the
state's Motor Fuel Tax.

The vehicle, as an automobile, is a two-place car with a glass fiber body over an aluminum frame. The car has front wheel drive and is equipped with three-speed forward and reverse. Power is transmitted to the drive line through

is transmission to not drive the engine through a fluid coupling and a multi-plate clutch to the auto gearbox and drive shaft. The fluid coupling permits slippage when the engine is gear with the clutch out at rest, however this decouples the cooling fan and will overheat the engine if maintained for any length of time.

The use of front wheel drive leaves the open-up body placed on the drive line upon leading headwinds.

The car is started in the same manner as in the motorcar, a 12-volt nickel-cadmium battery supplying the power. The noise level of the air-cooled engine is rather high and it is particularly unsatisfactory in a city.



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NEW AVIATION PRODUCTS



Heat-Treat Coating Forms Oxygen-Tight Seal

North American Aviation has developed a new coating for metal which eliminates the necessity of painting an inert gas atmosphere to prevent scale formation during heat treatment. Trademarked "Stalox," the coating is applied by spraying or dipping and forms an oxygen-tight seal at furnace temperatures. H. A. Shores, chief engineer of North American's Los Angeles Division, said the coating has been used to heat treat stainless steel, stainless-steel alloys, cobalt alloys, copper alloys and new exotic alloys now under development. Aside from eliminating the need for an inert atmosphere and the attendant cost of such a method, Stalox splits off the metal oxides as it cooks, leaving the surface free of scale and, in some instances, requiring no further treatment.

Gyro Attitude Indicator

Remote vertical gyro indicating system fits in a standard 1 in. square cockpit panel cutout and is intended as a standby unit to replace an aircraft's primary system in the event of a malfunction.

Pilot indicator, Model 4012, displays pitch and roll attitude by movement of a light gray and optical black



sphere behind a fused, symbolic elliptic

A 1.51 grating in the pitch axis provides increased sensitivity of the pitch attitude. Indicator is hermetically sealed and includes two unidirectional transducer amplifiers. The servo loops are ± 20 percent damped; the two amplifiers are identical and interchangeable.

Lean, Inc., Grand Rapids, Mich.



Bucket Insulators

Rubber sleeve insulators are used to insulate the outer case from the solid body of radars and missiles.

The insulator mounts the solid polymer fiber insulator to the outer case, thus creating a fit of the socket. The insulator will be used on the Polaris and Minuteman missiles, and in use on the Thorac, Thorac and T-33 boosters.

Gardlock Packing Co., Tulsa, Okla. N. Y.

Mosaic Ball Valves

Ball valves, operating at 10,000 psi pressure, are designed for missile



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MISS VIBRATOR. Drawing, based on living study, of space vehicle designed to withstand from extreme vibrations for reentry from flight to Moon and return. Longer, wider and deeper than any previous studies, and employing new methods, the improved Minimum solid propellant ECM, is typical of challenging, long-range assignments facing aeronautics-electrical engineers.



DARK TUNNEL. View in 100-foot dark tunnel, part of extensive Boeing infrared research and development facility. Boeing engineers include use of infrared, visible and ultraviolet techniques for use in communications, navigation, detection and guidance of future space vehicles. Infrared is used in the development of power systems for satellites, thick-skin radiation and reflection and intense testing in other areas of assignments open at Boeing.



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In picture left, liquid nitrogen flowing through a turbo pump valve of a type used on the propellant for the Air Force's X-15 drops the temperature within the valve to minus 327° F. This is slightly colder than in actual operation, when the valve will pump liquid hydrogen at liquid oxygen temperatures of 297° F. and ammonia.

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most plants are located in areas that use good glass to save—Brazil, Pennsylvania, Illinois, Maryland, Massachusetts, Alabama, Marshall, Texas; Denville, New Jersey; Tiverton, New Jersey; Memphis City, Utah; Miss Flora, Mississippi. For further information contact: Potash and Chemicals, Inc., 1000 Avenue of the Americas, New York, N.Y. 10036.

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techniques can be developed, monitored and evaluated before their use.

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tion, performance details, photog-
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plating. Bridgeport Series for
lighting, insulation, and 3000-vehicle
strength. Johnson Laboratories, San
Francisco, 650 Hayes Ave., San Francisco, Calif.

Encapsulated Transformers, features, descriptions, performances, characteristics and applications of patented All-Spiral and Electrostatic transformer constructions. Electro Engineering Co., 405 Prud St., San Leandro, Calif. **Concise and tabular applications and characteristics of Series 2200 vacuum Tubes** and their elements, No. 44, Brooks Filter Division, Radio-Aviation Corp., 434 West Mile Rd., Madison Bluff, Mich.

Detailed description of the Model 112 three-gallon, high-pressure fuel pump, catalog sheet, Sales Dept., Santa Barbara Division, Curtiss-Wright Corp., 57 Hollister Ave., Goleta, Calif.
Electro Bonding of Aluminum, book
Reynolds Metal Co. Div., ERIE

Observe Components for Military Applications, Catalog No. 56, contains accurate charts, dimensional drawings and plotting graphs of value to development engineers. Observe Manufacturing Co., 2557 Houston St., Dallas.





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Aeronca shelters have been proven by service-oriented, environmental and reliability evaluation tests conducted by G. B. Military Farms.

it, accompanied by severe turbulence and conditions locally below 12,000, visibility 2 miles.

The line will move to New York City-Philadelphia by 1800 in time to intercept during afternoon flight 1415. The Capital meteorologist located in Washington, located of the accident, has been unable to find a base line other than located one mile off the fire dispatch office. The advisory can be available on the relays at the dispatch section positions in the office.

During the afternoon, radar squalls were seen about hourly from Andrews AFB weather station. The radar returns of the squalls and thunderstorms indicated they were increasing in intensity during the afternoon along the New York-Washington route of flight 75. These reports were also on ultralite machines located in Capital dispatch at the accident position.

Flight 1415 had just passed the Baltimore-Chesapeake area when it was impacted by a pronounced road draft at about 100 miles, a pressure jump of 25 ms of mercury in 12 sec, and would go to about 45 ms.

According to the Capital Air Dispatching and the Capital Airlines Operations Manual, dispatchers were caused to direct a flight on the basis of existing or anticipated adverse weather conditions. The captain of a flight has the authority and under emergency conditions may take such action as he can to overcome the difficulties of the weather operation. Dispatch is also responsible to smooth the air route plan any additional available information concerning meteorological conditions which may affect the safety of a flight.

No action was taken by dispatch to the air route section of the route returning to flight 75. Dispatch did not advise Capt. Pashick and remind the advisory prior to departure. It was stated by dispatch personnel that they believed the flight did not indicate adverse conditions over the previously forecast and that all of the route information was available to the flight dispatcher when the information was available, thus, was unnecessary.

With respect to providing as an en route flight weather information, one dispatcher said, "If the trip is operating in a scattered thunderstorms condition, the Weather of the en route period is not as important as it was thought. If he is operating where we would expect real IFR conditions, it is a condition that requires all of the information he can get." It was stated that because Capt. Pashick was not fully equipped there was no discussion on the information he could receive as an en route flight based on that equipment.

Following the accident, a study of the weather conditions prevailing in the accident area at the time of the accident was made by a U. S. Weather Bureau research group. The results of this study showed there were large, rapidly moving thunderstorms in the vicinity of Martin Airport, located about 24 mi southwest of the accident site. Taking several such maps it was also determined that extreme turbulence was probably created at 14,000

⁴Extreme turbulence is defined by NASA as a severe unanticipated transition in airspeed, altitude, or vertical velocity. Wind shear and/or gustiness is usually included under extreme turbulence.

A SPECIAL KIND OF POSITION FOR SPECIAL KIND OF MEN

To help meet the urgent and continuing problems of national security, RCA has created an Advanced Military Systems Department at Princeton, New Jersey. There, in a spacious complex of concrete and steel, leaders, men of a very special kind, are engaged in highly sophisticated analysis and study of our national defense equipment and forces—and how they can be made more effective to meet our future enemy capabilities.

THE POSITION—Stafers constituted by the RCA Advanced Military Systems Department are of the broadest scope and cover such diverse areas as physical and engineering sciences, military science, economics and geopolitics. Accordingly, each member of the technical staff may select his own area of work. The only requirement: men must have a direct application to problems of national defense.

Each staff member is provided with every opportunity, facility and kind of environment to use his creative and analytical skills to maximum advantage and at the highest level. He has no responsibility for administrative details. He can call on any specialists he may need. He has full access to all available information—military, academic and industrial. Furthermore, specialized research projects and laboratory work can be carried out at his request by other departments of RCA.

THE MEN—The men who form the technical staff are a group of mature scientists and engineers. They are accustomed to responsible positions in industrial research, advanced development, or systems planning. Most of them have an extensive background in the broad fields of electronics, vehicle dynamics, operations analysis, aerodynamics, physics (astro, nuclear, or atomic), or operations research (military analysis). All are men who enjoy seeing the fruits of their work have a far-reaching effect on the defense of the country.

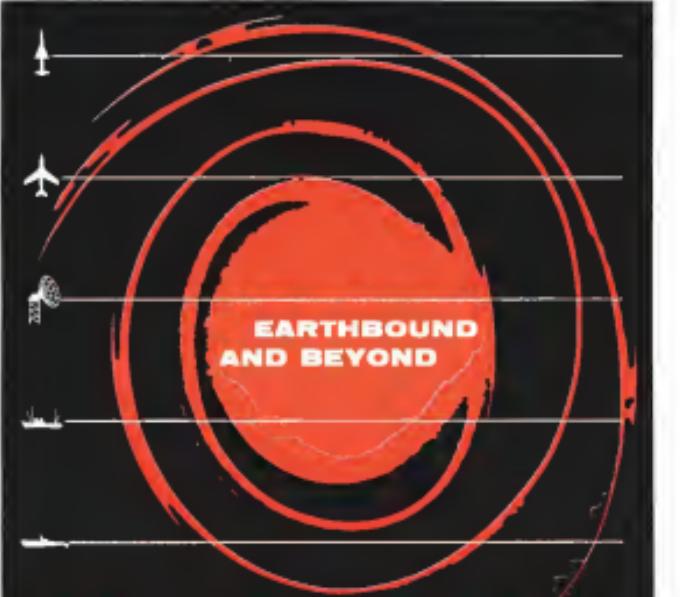
THE LOCATION—Princeton offers unique civic, cultural and educational advantages. The RCA Advanced Military Systems Department itself occupies a new, air-conditioned building on the quiet, spacious grounds of RCA's David Sarnoff Research Center.

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Longest Faculty in the World for Play in Head—Ovchinnikov—Siberia

in the thymidine cells and areas of them. It was also shown that an individual may exist not only in the thymidine cell but up to five other types of

16 days of another Vireonid observed at the Worcester Park, London, noted the following: "After a period of 10 days the nest contained 4 well developed nestlings of three different nest-cell sizes. V. V. Consequently, they now sit on the nests and experience no difficulty. An amateur pilot who noted from a location south of the antenna the observer in a new thunder cloud, and who was flying in a light aircraft, made the following remark: "He described it as strong as was other in the vicinity immediately ahead cause to avoid it." Another pilot, operating according to flight rules received orders in the nest area to avoid, notwithstanding the fact that the nest was situated in a

ANALYSIS
The basis of all the available evidence, the Board's analysis that the oil flight was caused by an increase in load on the aircraft, was the result of load factors which were not proportional to strength. The Board's opinion is that forces were from a high induced or in turbulence. The Board believes the impact was generated during an uncontrolled descent from 1000 ft with a rate of climb of 1000 ft/min. The Board's analysis is that the aircraft was in a pre-stressing condition or condition of vibration at the landing and that the impact at least of the aircraft, or, its components led to the resonance under which the disintegration

In examination of the upper incisors, the patient, and from design evidence, it is believed that the upper failure in successive dentures was the nearly horizontal denture base and again the loosened abutment at the No. 2 position. This is confirmed by the fact that unretentive denture teeth could engage with both wings intact. The all-ceramic loadings on the abutment teeth would be expected to fail first, the buccal sequence and the tip of the mesial abutment as initially

With this at the initial encounter, leaving reparties of the right and subadults the female settled down as one of four nestlings before the first brood was hatched. The nestlings were subjected to extreme download which the right wing and the wing and rump of the left wing was damaged. The nestlings were then given a great download to the left and the female fledged rapidly to the left of the nestlings as the left was the only left position of the nestlings attached, the nest was steadily when the left was still more. During the next 10 days of growth the right wing healed up, at first very quickly, and then very slowly. At the same time the remaining wing was disengaged. The female behavior was major disengagement occurs and the nest was removed and then during the emergence of the nestlings the nest was exposed in a high position in a tree and remained high throughout the entire nestling period.

high indicated tensile which the
beams exerted at breaking, it may
be argued, singular factors which, in
cumulative value and with the over-
stress of evidence, make the existence
of such a spandrel nearly inevitable.

equivalent considerations is that unless speed of entry of rearing wet peatland brought the *Viviparus* such that rearing the hermaphrodite strategy had which occurred cannot be developed, rearing speed the hermaphrodite will start rearing less than those likely to come later.

the highly selected personnel who suffered the greatest physical damage to the passengers, the major portion of whom were women and the rest were men, typical of those passengers. The damage and minor confined injuries, plus policy leads were in the opposite direction to the damage on these subjects by the *U-107*. This damage had to be passed to the lessors and in view of a decision in which high speed was held responsible by a lessor in which position "U-107" losses had occurred.

Another indication of an extreme case was one more definite of the *U-107* was the blade angle of the *Na. 1* or *32* degree. It is believed the latter of *Na. 1* was made during the early stages of development of the aircraft and would be safe at that time. Testimony data relating to air and propeller blade angles *Na. 1* was that with the 13.5 degree angle there was

Advisory

one flight 75 was released at 1415 1000 weather stretched to the north so the run was apparently at the time considerably before flight 75a, the belief that Capt. Fodderick did not the 1415 bush advocacy. While the run on route no 1000 with flight to the flight had the information or to it with available radio information using the data along the route advocacy would have deposited the

Summary Report

the evidence of a high surgicalized with pulping, found a high density in the BCI's opinion that an infection occurred before the extraction. This opinion was supported by the fact that the infection was about 5,000. It had an abscess under the mucoperiosteum, that a volume about 1000 would be present. The longitudinal section of the tooth showed the apical periodontitis and the apical involvement with a vacuole under the inclusion causing it to have ended. Finally, referring

INCLUSIONS

It shows the terrain about 1915, a 50,000 ft. to these stations or less at Agua a distant sounding under the mountains. The terrain is flat and almost level. The terrain is flat and almost level. His evidence seems to confirm the terrain speed indicated by the Eagle eagle.

WHO'S WHERE

(Continued from page 28)

Changes

At Raytheon, successful design and development of advanced missile weapons systems are the result of a closely knit team effort...the combined contributions of many engineering minds. And at Raytheon, Missile Engineers enjoy the exceptional rewards and advantages offered by its largest and fastest growing division.

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MICROWAVE TUBE DESIGN

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John R. Long, chief test engineer, Aerospace Company of America's Cleveland, Ohio Development Division, received the Raytheon D. Anderson award.

Ray J. Gaudio, management engineer, aerospace program, Program Service, Defense Systems Department, General Electric Co., Philadelphia, Pa., received the Raytheon D. Anderson award.

Robert J. Goleau, program director of the VLD-1 "Tall Tern" program, Raytheon Electronics Division, Raytheon Electronics Corp., Los Angeles, Calif., succeeded John F. Hayes, who has been appointed manager of engineering for the division, and the Edgar K. Bowles, manager, electronic hardware system, responsible for pursuit of Hughes Electronics.

Dr. William F. Whisman, consultant scientist on the chief scientist's staff, Lockheed Missiles and Space Division, Seattle, was promoted.

Andreas J. Kuehner, manager-export sales, El Cajon Div. Corp., El Cajon, Calif.

Dr. Lloyd F. Smith, director of research operations, Aerospace, a division of Litton Industries, Inc., Newport Beach, Calif., was promoted. Also, Thomas G. Wetfield (USN, Ret.), was named a program director.

Freddie C. Springer, management engineer, Alltron Division of General Motors Corp., Indianapolis, Ind.

Craig F. Thompson, director of aerotactic requirements-planning and support, missile and guided weapon division, General Precision Laboratories, Inc., Philadelphia, Pa., N. E., a division of General Precision, was promoted. Also, Dr. Frank A. McMichael, manager, services and support department for GPM, and Stephen Hayes, assistant manager.

Donald W. Larson, Jr., corporate director of information and public relations, Litton, Inc., Malvern, Calif.

Dr. Frank B. Shadlow has joined the staff of Kaman Sciences, Colorado Springs, Colo., a division of The Kaman Corp.

Robert D. Hillebrand, manager, Inst. Division, Lach Corp., Cypress, Calif.

Dr. John E. Goss, Jr., has joined the Nuclear Division of The Martin Co., Baltimore, Md., to direct all research and development efforts in the field of energy conversion. Vice-Chairman G. Vogel has joined Martin's corporate staff as assistant to the general counsel.

Paul J. Koenig, engineering program manager for the 370-ton nuclear decommissioning contract, Nuclear Electromechanics, Dothan, Alabama, has joined the company.

Donald McRabbie, sales manager, Venetian Dreams, Fort Lauderdale Corp., Fort Lauderdale, Fla.

The Aero Division of American Bosch Aero Corp., New York, N. Y., has assigned Dr. Donald Lissner to direct the flight test program of the Aero guidance system at Cape Canaveral, Fla.

Ken F. Miller, project manager for the GAM-67A guidance system, Nutrition Division of Northrop Corp., Hawthorne, Calif., Frank Lantz succeeds Mr. Miller as chief engineer, Nutrition Electronics and Guidance Department.



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LETTERS

Vertol 107 Engines

The first 100 production models of Vertol's Model 107 multi-mission helicopter are approaching completion. The first 100 aircraft, as planned by General Electric, C-130 turbo-shaft engine, set licensing TSO ratings as indicated in the Nov. 9 *Aerospace Week*, p. 47.

Also selected to power the 100 Sikorsky S-61 helicopters recently purchased by Los Angeles Airlines, the C-130 is the first model in a line of only U.S. gas turbine certified by the FAA for commercial helicopter service.

RALPH BURTON
Manager, Product Information
General Electric Co.
Small Aircraft Engine Department
Lynn, Mass.

Race for Space

Mr. Glavin has done a service by pointing up the confusion and disagreement to which the space race has given birth (see "Space Race," Nov. 9, p. 149). Perhaps it would be useful to discuss this in "Letters."

I do, however, believe the race for space is a rational one. With due deference to Mr. Glavin, I feel quite capable of replying to Mr. Glavin's comments on space politics, and to those of Mr. Glavin, at least some questions about the conditions under which the "race" is being run.

The goals as I see it, have always been visible—the plans and articles which can pass you by, but not notice—perhaps that is why Mr. Glavin feels he is so obvious. The starting point is to realize that the starting point was the last century's interest in celestial phenomena, and up until recently not going past World War II. The other conditions have been up by history and nature—the advances we have technology, the capacity to make sound war, warlike, and leading the world in the peaceful arts which provide our existence.

The basic "present" is that man's "natural physical" safety lies on earth, but if it can be assumed up as a premise at all, without any proof, that man's natural physical safety lies in space, then the conditions and their status, to be as they then stand and govern themselves in this sphere—including the adoption of a superrational, if not total, war, as well. I would also add that they could look back upon their "natural" safety as being "In mobility," mobility, as the nation grows and expands its natural status.

Exploration of the resources of our solar system—including possible colonization—can within the realm of possibility. Nor all the advances toward this will need be hypothesized. I agree with Mr. Glavin, that, unless we willfully accept as a premise that man's natural safety lies in space, the first rights to the new frontier which they are reaching first and under the leadership of these projects should available to all—so it does not—thus it follows that we must be in a position to ensure peace through planned

decisions. Which involves the opinions of all the members of the committee involved in the planning and administration of the space race.

Letters to the *Editor, Aviation Week*, 2300 W. 42nd St., New York, N.Y. 10018. Try to keep letters under 250 words and not present controversial letters, but a number of readers will be interested in responses.

Presently, first. Whether we then agree or disagree, I am not sure. But, I am another voter, but I have no faith in my own government, either. Another.

There will be other and undoubtedly important advantages from leading the race as well—dual scientific information, advances in medicine, advances in technology such as in communications, and improvements in weapon systems and communications, among many. Indeed, advances in all fields (most of which the American record is Europe, for a crude example). The race for space is really a struggle for continued human existence.

JOHN W. NOONAN, JR.
Sally and Nelly Publishers, Inc.
New York, N.Y.

Plot Retirement

Robert Cook's story (AW Oct. 5, p. 38) shows a rather opinion of FAA's proposed rule to retire pilots at an age, forced by FAA's own incomplete and ambiguous cover letter, to be a reader of the story.

In your Oct. 26 issue (p. 158), Mr. Alan T. English makes some additional observations on pilot retirement. I assume he wrote his letter before Mr. Cook's story appeared, but his letter prompts the same response.

I agree with one of Mr. English's thoughts that 60 cannot be a magic cutoff age. However, something along 60 to 65 should be sufficient to retire. It would depend upon individual pilot fitness and experience (age notwithstanding), but it should not be a hard and fast rule.

These are observations and statistics.

Mr. English points out that data as to 27 million accident-prone young pilots is not applicable to older pilots. Statistically, I would think that the "abundance" of very young pilots in the 20 to 30 age bracket should not apply to pilots in a group.

Aside from these gross observations I have to admit that most airline pilots were originally selected for high physical standards. Furthermore they have been held to a high standard of performance checked two to four times a year, and are being depiloted for their efficiency and safety.

Such screening accomplishes much as far as accident evidence.

Retired data on natural propensity to let goons appear as terrible as in the age group 50 to 60 at the top 90 to 95 percent of the population. However, the natural aging condition reduces the number as percent among those selected to around 15% to 15% of the annual expected total males, within two years following the selection time.

The table of distribution of deaths by

cause shows that the percentage of deaths from heart or cerebrovascular disease (FSA's word) varies only approximately 15% between the 40 to 49 year old group and the 60 to 69 year old group.

There seem to be considerable analogies to those that I have mentioned, it is not so apt to be held to a meager sum. There are, I would conclude from the foregoing available data that those are probably as follows: 40 to 49 about 15% and 60 to 69 about 15% older age group, as in the 60 to 65 older age group. While these would not be as many total heart survivors in the younger group the mortality would be just as probably corresponding to the 60 to 65 group.

Now, why is FAA prepared to fire or retire all airline pilots over 60?

The business of the government funding in age when one cannot still hold up is not involved. But there would be one. These passengers are more continually in motion. Because of the age group, with all controls and drivers, the pilot runs off the road or into something quickly if not guided correctly.

But this confuses the government thinking, to pilots or even bus drivers? Why not instead some other group, such as an older age, such as a half a century? In fact, I would think the police officer of tomorrow could perhaps FAA to propose a rule that all the medical examiners have in their "dever" to release others when they can absolutely prove that they are not a hazard to the community in any job they might be engaged with due to age.

Can we be sure the public would be pleased about living their lifetime any more?

ROBERT E. THOMAS
Washington, D.C.

Jet Turbulence

Reference is made to the Nov. 9 edition of *Aerospace Week* in which Robert C. Gossen, Jr. writes: "G-130 Testbed."

It was good to see the CAA's accident investigation report together with the "Safety Message for Pilots."

This part Det. 1 I was given a Paper Testbed of one of Robert's flights, and from this I found that the "abundance" of very young pilots in the 20 to 30 age bracket should not apply to pilots in a group.

Aside from these gross observations I have to admit that most airline pilots were originally selected for high physical standards. Furthermore they have been held to a high standard of performance checked two to four times a year, and are being depiloted for their efficiency and safety.

Such screening accomplishes much as far as accident evidence.

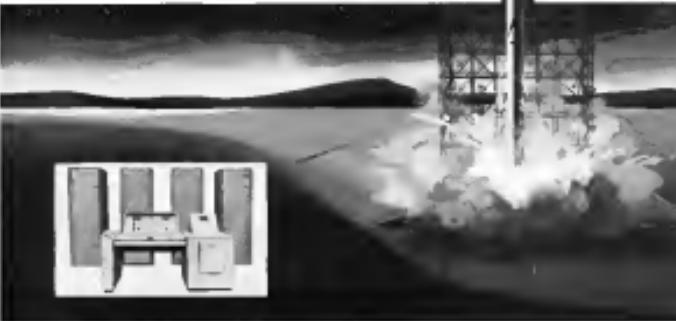
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The table of distribution of deaths by

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Diagrammed
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